

Nuts & Volts

Exploring Electronics And Technology For The Hobbyist And Professional

December 1998 Vol. 19 No. 12



Merry Christmas
from all of us at
Nuts & Volts

U.S. \$3.50 CANADA \$4.50



**BOTH SINGLE AND DUAL DRIVE
MODELS AVAILABLE.**

**MULTIMEDIA PROCESSOR
ACCELERATES DUPLICATION.**

**EXTERNAL SCSI-II PORT WORKS
LIKE A STANDARD CD WRITER
FOR CREATING CUSTOM DISKS.**



**TOTALLY SELF CONTAINED,
NO CONNECTION TO A PC
IS REQUIRED.**

**INTERNAL A/V HARD
DRIVE STORES DISK IMAGES
FOR MULTIPLE COPIES, AND
CUSTOM AUDIO DISKS.**

**ADVANCED FORMAT
DETECTION PRODUCES
PERFECT DUPLICATES ON
STANDARD CD-R MEDIA.**

COPY ANY CD INSTANTLY. NO PC REQUIRED.

CD DUPE-IT!

Instantly duplicate CD-ROM disks for software distribution. Make backup copies of your favorite software on rugged, permanent media. Produce disks quickly and economically. No mastering or multimedia experience is required.

Insert your original disk and press "start." The multimedia processor quickly copies any disk to the internal A/V hard drive. Insert blank disks and make as many copies as you like. You'll produce identical, bit-for-bit duplicates. The system is totally self contained—no connection to a PC or Mac is required. Just

**BUY MANUFACTURER DIRECT: \$995
408 330-5542**

plug in the power cord and press "start"—it's that easy.

You can even make your own custom audio disks without a PC! Insert your original CD's, select the tracks you want, and CD Dupe-It will copy them to the internal hard drive. Then insert a blank CD, and you'll have a custom audio disk with just the songs you want.

With the included CD mastering software, CD Dupe-It will work overtime as your personal CD mastering system. Just attach a SCSI

cable to your PC or Mac, and you're ready to design and create your own original CD's. Similar systems used in duplication houses cost over \$10,000. Now you can easily copy disks yourself for a fraction of the price.



CORPORATE SYSTEMS CENTER
3310 WOODWARD AVE., SANTA CLARA, CA 95054
WWW.CORPSYS.COM

Software publishers—ask about our high-volume multi-drive duplication systems. CD Dupe-It is sold and intended for backup and in-house design purposes only. Copyright laws must be observed.

HSC Electronic Supply

Serving
Silicon Valley
since 1964!

...brings you a potpourri of high-tech goodies for the techno-tinkerer!
For thirty years we have been your source for Silicon Valley exotica!

CyberEye Color Video Camera!



- High-quality (nice looking too!) composite color camera
- 1/4 inch CCD sensor w/auto white balance control
- Resolution: NTSC 542 x 492 (250,000 pixel)
- Manual focus knob/ring, 5mm to infinity
- Power: 5.0 VDC @ 180 mA. Supply from PC or keyboard power...no external adapter needed!

HSC#17535 \$69.00

ATX Pentium Power!

- Support for Intel Pentium 90-200, 166-200 MMX CPU's
- Also supports Cyrix/IBM 6x86 P, PR 150 & 166 CPU's
- Also supports AMD K5, and, with special VRM, K6 CPU's
- 4 PCI slots, 4 ISA slots (one shared), 16-bit stereo sound
- 4 DIMM RAM sockets, parity or non-parity, ECC, EDO, FP
- On-board 2 x IDE, 2 x 16550 Serial ports, 1 parallel port
- New, 90-day warranty (CPU not included)



HSC# 80437 \$49.95

- ATX style Midtower case, fits above motherboard
- "Netpower" logo on front, never used, 90-day warranty

HSC# 17517 \$29.95

Drive-bay Amp & Equalizer

- Made by NEC, fits into standard 5.25" drive bay
- 5-Band equalizer has 4 channels, 6 watts RMS/channel
- 25 watts RMS total power output
- Headphone jack on front panel
- Connects to drive power connector
- No special software or drivers req'd!
- Compatible with any sound card
- Brand new, 90-day warranty



HSC#17534 \$19.95

- Also available, amplifier kit with matching speakers
- Same amplifier unit as above
- NEC Speakers are 11" tall, 4.5" wide
- Speakers have 4" 40-watt woofer, 1" dome tweeter
- Includes all cables, hookup accessories
- New in plain brown box, 90-day warranty



HSC#80462 \$39.95

PC Power Supplies

- ATX-type perfect for use with case, motherboard at left!
- ATX supplies have 5V @ 25A as well as 3.3V @ 15A
- Our XTC312 comes with a 1-year warranty!



#17316 200 Watt Std PC \$17.50

#XTC312 250 Watt ATX \$39.95

Fujitsu 1 GB Drives

- Model #s M1606S, M2694E \$ M2932SA
- SCSI Interface - 3.5"
- Tested good and DOS formatted
- Used - w/90-day warranty!



HSC#17555 \$89.00

Video-hacker Dream!

- Logitech Videoman Video-conference camera & interface
- These units were sold with Hewlett Packard S-700 workstations for videoconference capability
- We do not have technical data, software or manuals
- All we have is cameras with stand, and SCSI-II interface
- The camera is on a weighted stand that extends from 13" tall to over 20" tall, and has a stereo microphone
- Color camera is digital output only (not NTSC) as far as we can tell -- but who knows?
- Interface box has two SCSI-II ports on back, and a DC power input (we do not have the adapter), and on the front it has a mic. out jack, composite video out (BNC), and the connector for the camera cable.
- Note: HP and Logitech will provide no information on these



HSC#17503 \$39.95

RAID Server Chassis

- Trimm H420 Super Server rack-mount chassis will accommodate a high-end multiprocessor system board with a PCI RAID controller.
- Slots for eight RAID drives on removable slides
- Space for two CD-ROM or tape drives
- Three hot-swappable power supplies (300W) included
- Environmental processor and LCD display
- Supports ATX motherboard (not included)
- Can also accommodate Alpha or SPARC system boards
- Three 95 CFM fans and one 17 CFM blower
- Measures 17.75" high, 19" wide, 17" deep
- New in box, with rack slides, 90-day warranty



HSC#80463 \$395.00

Corel Office Professional 7

- Great Software Bundle -- Amazing Value!
- Includes Corel Wordperfect 7, Corel Quattro Pro 7, Paradox 7, Corel Presentations 7, CorelDRAW 6, CorelFLOW 3, Sidekick 95, Netscape Navigator, Dash board 95, 1000 fonts, 10000 clip-art images, more!
- For Windows 95, Windows NT 3.51 and Windows NT 4.0
- Distributed on CD-ROMs, with hefty manual pack
- New, shrink-wrapped in box, 90-day warranty

HSC#80436 \$47.50

PCI-Bus 56K Modem!

- Genica PCI-Bus 56K Modem at unheard-of price!
- Data, FAX, voice, full V.90 compatibility
- Voice from handset
- Windows 95/98 or NT only (Not Win 3.1 compatible)
- Uses latest Lucent chipset, comes with Lucent drivers
- New retail box, with Trio application software on CD
- 90-Day Warranty



HSC#17532 \$39.95

FM Tuner for your PC!

- Listen to FM radio while using your computer!
- Set up to 24 programmable stations
- Even works as an alarm clock (sorry, no snooze button!)
- Compatible with DOS/Windows/Win95/Win98
- ISA-bus card, receives from 87.5 to 108 MHz
- New OEM pack with antenna, audio cable, software, set-up guide -- works in combination with your sound card.
- 90-day warranty

HSC#17533 \$12.50

1.0 GB IDE Hard Drive

- Model P1000-2AF by JTS
- 1942 Cyl. 16 Hd. 63 Sec.
- Very thin -- only 5/8" High!
- Each drive fully tested and DOS formatted
- HSC 90-day warranty



HSC#17618 \$49.00

PCMCIA Sound Card!

- Media Vision PCMCIA Sound Card
- Great for Portables, Laptops with PCMCIA Slot
- External pod has joystick port, mic. input, line in & line out jacks, volume control.
- Install software, inst. included.
- Win 3.x, W95 compatible
- New in OEM pkg (no box), 90-day HSC warranty
- We had these before at \$39.95 and they went fast!



HSC#17036 \$29.95

Pentium-Pro Power!

- High quality Micronics motherboards using the Intel Pentium-Pro chip at incredible savings!
- D6-IN "Invader" AT motherboard has 4 PCI, 3 ISA slots
- Built-in Primary & Secondary IDE controller, floppy controller, IR port, 2 SIO ports, 1 PIO port
- Comes with tested 150 MHz CPU installed
- Supports up to 384K memory (72-pin SIMMs)
- Comes with instruction book, I/O Cables & bracket
- New in box, 90-day warranty



HSC#17629 \$119.00

- W6-LI "Lightning" dual CPU board has 4 PCI, 2 ISA slots
- Dual Processor motherboard, can use 1 or 2 CPU chips
- Comes with one tested 150 MHz CPU installed
- Voltage Regulator Module for second CPU included
- Built-in Primary & Secondary IDE controller, floppy controller, 2 USB ports, IR port, 2 SIO ports, 1 PIO port
- Also has Adaptec "Ultra-SCSI" fast SCSI Bus Mastering controller with 50-pin port and 68-pin ultra-wide port!
- Also has Creative Labs "Vibra 16CL" sound on board!
- Supports up to 512K memory (168-pin DIMMs)
- Full Manual & Disk set (SCSI, sound, etc.), I/O Cables
- ATX-style motherboard, new in box, 90-day warranty



HSC#17624 \$199.00

Super Skinny Laptop Floppy!

- Citizen W1D 1.44 MB floppy measures only .43" thick!
- Interface is 26 conductor 1mm pitch printed ribbon cable
- Short (1.25") ribbon cable included
- Black bezel -- New OEM Pack, 90-day warranty
- Sorry, we do not know which laptops will accept this drive!



HSC#17587 \$35.00

Cases!...Cases!...Cases!

- Mini-Tower, 3 - 5.25" and 4 - 3.5" bays
- One slot for 3.5" drive on front panel
- 15" H x 7" W x 16.5" D
- Takes standard mini-tower supply
- See our #17316 (this ad!)



HSC#17481 \$12.50

- Full-sized tower case, for AT or ATX!
- Comes w/AT-style power supply
- ATX cutouts on rear panel, just change to our #XTC312 ATX power supply!
- 24-1/4" H x 7.5" W x 16-3/4" D
- Brand new!, black in color



HSC# 17544 \$42.50

- AT-style Mid-tower
- Extra PIO and SIO slots on rear panel!
- 18.5" H x 6-5/8" W x 15.75" D
- Three 5.25" and two 3.5" front bays
- Brand new!, black in color



HSC# 17543 \$37.95

- ATX-style mid-tower cabinet
- Power supply included
- Three 5.25" and two 3.5" front bays
- 16.5" H x 8.25" W x 16.5" D
- Brand new!, 90-day warranty



HSC# 80459 \$59.50

- Full-size tower bargain at a great price!
- Five 5.25" and four 3.5" bays!
- Extra SIO & PIO connector cutouts!
- Great for backup server...etc
- Requires old-style larger power supply (ask for stock check...we might have it!)



HSC# 17504 \$15.00

Ludicrous Laser Pointer!

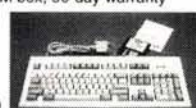
- How can we do this!...we don't even know!...
- Small, handy laser pen keychain pointer.
- 5 mW!, bright red laser with tight beam
- Brushed gold finish with spring-loaded clasp
- Brand new, with batteries and instructions
- 90-day warranty.



HSC#17383 \$12.50!

Parallel-Port Keyboard!

- Perfect for notebook computers, laptops, palm-tops, etc.
- Full-size 101 keyboard by ALPS, model LPT 101
- Includes manual, installation diskette with Win 3.1 drivers
- New in OEM box, 90-day warranty
- New Price!



HSC#17160 \$39.95

Workhorse Hard Drives!

- Seagate with SCSI interface full-height drives
- Good, Reliable drives for many applications
- Choose from 670 or 330 MB size
- With 90-day warranty!



HSC#17556 ST4766N \$35.00
HSC#17557 ST4385N \$29.00

Halted specialties co. HSC Electronic Supply

Toll Free (Orders Only) 1-800-4 HALTED
Internet World Wide Web:
3500 Ryder St., Santa Clara, CA 95051
4837 Amber Ln., Sacramento, CA 95841
5681 Redwood Dr., Rohnert Park, CA 94928

(1-800-442-5833)
<http://www.halted.com>

(408) 732-1573
(916) 338-2545
(707) 585-7344

FAX your orders to:
(408) 732-6428



Visit HSC's Website!

- Pay us a virtual visit on the World Wide Web!
- Simply point your browser to <http://www.halted.com>
- Site is constantly being revised, please visit often!
- Check out the amazing "Gizmo of the Week" feature!

HSC Catalog online!

- That's right, get HSC's catalog on the World-Wide Web!
- Simply go to www.halted.com and follow the big red link.
- Adobe .PDF files are available for download and viewing.
- Or drop on by and pick one up...we'd love to see you!

Terms: Some quantities limited; all items subject to prior sale. Minimum order: \$10.00 plus shipping. Orders under \$20.00 subject to \$2.00 handling fee, in addition to shipping. All orders shipped FOB Santa Clara, CA (this means you pay freight!) by UPS Surface (no P.O. Boxes) unless otherwise specified, in which case prevailing carrier rate plus \$5.00 handling fee applies. Prepaid orders that don't include shipping charges will be shipped freight COD. There is a \$5.00 UPS charge added to shipping charges for COD shipments. If you have questions about your order, please call Customer Service at (408) 732-1854 M-F 9AM to 5PM PST.



OPTOCOM PC-CONTROLLED COMMUNICATIONS RECEIVER

Optoelectronics, Inc. announces the all new Optocom PC-controlled communications receiver. The Optocom is the only PC-controlled communications receiver available today that has the ability to decode and follow both Motorola and LTR trunked systems on any frequency band, including 400 MHz, 500 MHz, 800 MHz, and 900 MHz. Another exclusive Optocom feature is the capability to follow both trunked systems and conventional frequencies simultaneously. In addition to Motorola and LTR decoding, the Optocom also decodes CTCSS, DCS, and DTMF.

The Optocom is a high-speed triple conversion receiver that is the fastest PC-controlled communications receiver available today, scanning at speeds up to 100 channels per second due to another Optocom exclusive feature, pipeline tuning.

The Optocom also provides the exclusive store and scan feature, which allows the user to download up to 28 different frequencies or one talk group ID into the Optocom's internal memory for scanning away from the computer, an ideal way to track one talk group ID in mobile applications.

The Optocom also has a built-in data slicer circuit for decoding of popular FSK programs such as ACARS and WeFax, using third-party software.

Other Optocom features include a CI-5 port for reaction tuning by the popular Scout frequency recorder, squelch and volume controlled by both software and hardware, and dedicated decoder plug-in bus for future third-party applications.

For more information, contact:

OPTOELECTRONICS, INC.
5821 N.E. 14th AVE., DEPT. NV
FT. LAUDERDALE, FL 33334
954-771-2050 FAX: 954-771-2052
E-MAIL: sales@optoelectronics.com
WEB: www.optoelectronics.com

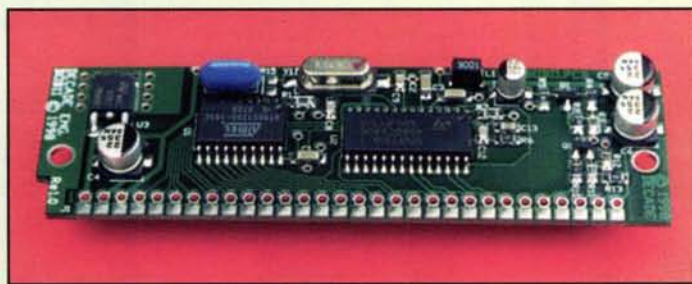
Showcase your New Products here! Send all press releases or information/photos to:
Nuts & Volts Magazine
430 Princland Court, Corona, CA 91719
or E-Mail to newproducts@nutsvolts.com

BOB II VIDEO TEXT DISPLAY MODULE

Decade Engineering announces BOB-II, their second-generation video text display module. BOB-II snaps into a common 30-pin SIMM socket and lets your PC or microcontroller display up to 11 lines of 28 characters – 308 total – in standard NTSC or PAL composite video systems. Basic character graphics and Euro language support are provided.

BOB-II generates matte background video on-board, or genlocks to your external video source and superimposes text over the image. Video mode switching is fully automatic. Character transparency and brightness are variable using external pots, if desired. You can draw attention to important messages with character blinking or background display options.

Programmed control of BOB-II is effected by simple commands and text sent as plain ASCII codes through a speedy (9600bps)



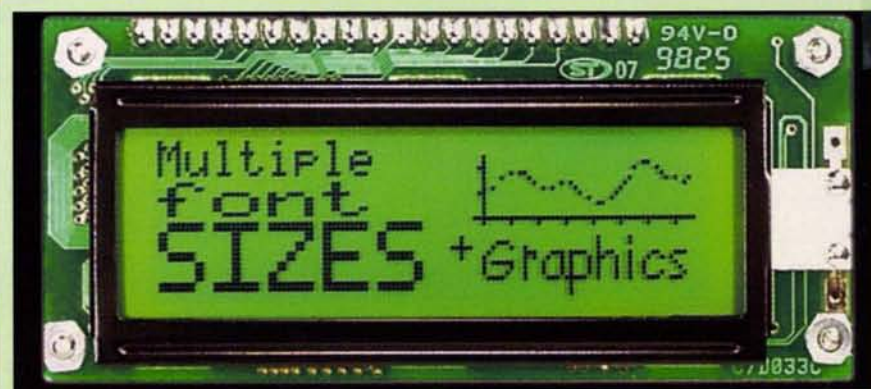
serial data link. Direct control from the PC keyboard is possible with any standard ASCII terminal program, e.g., HyperTerminal.

BOB-II requires 65 mA from an unregulated 12 VDC source, and offers a regulated +5V output to power associated equipment.

BOB-II (NTSC) pricing is \$79.95 for single units. The PAL version is slightly higher.

For more information, contact:

DECADE ENGINEERING
5504 VALVIEW DR. S.E., DEPT. NV
TURNER, OR 97392-9517
503-743-3194 FAX: 503-743-2095
E-MAIL: decade@worldnet.att.net
WEB: www.decadenet.com



SGX-120L SERIAL GRAPHICS LCD

The SGX-120L is a graphics LCD with a serial interface. It accepts data over a 2400- or 9600-baud serial connection (e.g., RS-232) and displays text and graphics on a high-contrast 120x32 pixel screen.

Text formatting is straightforward, using standard control characters like carriage returns, tabs, backspace, etc. Additional instructions tap the display's more advanced capabilities, like multiple fonts and font sizes from 4 mm to 8 mm (0.16 to 0.32 in.), automatic right-alignment, backlight control, and reversed (light-on-dark) printing.

Graphics capabilities include plotting points, drawing lines, and displaying full-screen images. The font and up to six screen images are stored in onboard EEPROM. Users can create or edit fonts and up to six screen images in a PC paint program, then download them to the SGX-120L using free software included with the display.

The SGX-120L draws only 10 mA with the LED backlight off and 60 mA with it on. At 80x36 mm (3.15x1.42 in.), it is the same size as a two-line by 16-character text-only LCD.

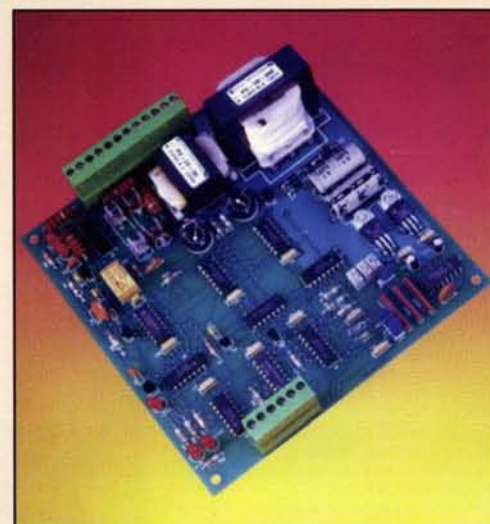
Pricing for SGX-120L (p.n. SGX-120L) ranges from \$99.00 (quantity 1) to \$69.00 (quantity 100+).

For more information, contact:

SCOTT EDWARDS ELECTRONICS, INC.
1939 S. FRONTAGE RD., STE. F DEPT. NV
SIERRA VISTA, AZ 85635
520-459-4802 FAX: 520-459-0623
WEB: www.seetron.com

ELECTRONIC MOP

A new electronic motor operated potentiometer for OEM and retrofit applications which replaces existing MOPs with a solid-state device that allows multiple operation stations from one PC board is being introduced by Waddington Electronics, Inc.



Featuring a separate rate adjustment for increasing and decreasing output and one to increase, decrease, reset, jog, and sum inputs, it has adjustable gain and offset with automatic reset after power on.

Providing differential inverting or non-inverting summing input, selective bipolar (-10 to +10 VDC) or (0 to +10 VDC) output, and selective inverting and non-inverting output, the Waddington Electronic MOP has opto-isolated control input signals.

This versatile board permits the use of internal isolated 24 VDC or external 5 to 240 VAC or DC signals to control inputs.

The Waddington Electronic MOP is priced at \$295.00 (list). For more information, contact:

WADDINGTON ELECTRONICS, INC.
25 WEBB ST., DEPT. NV
CRANSTON, RI 02920
401-781-3904 FAX: 401-781-1650
E-MAIL: johnwn@ids.net

Continued on page 91

Big sound from a stereo radio—without the big price!

Zenith Audio, a leading electronics manufacturer designs a "Small Footprint", "Big Sound" stereo system that's perfect for the home or office and priced below \$100.

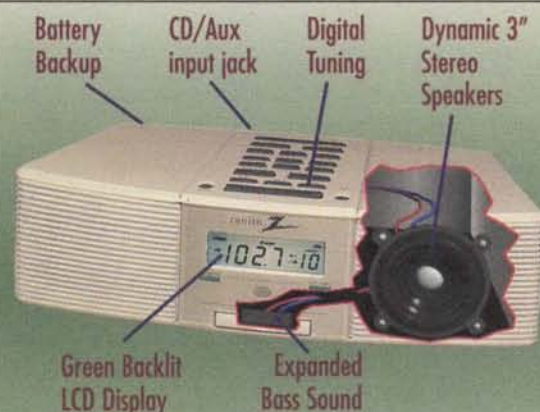
by John Jameson

I leaned back slowly in my chair with my eyes closed, listening to the haunting melody of a Mozart symphony. The acoustics were flawless, and the room was soon filled with full, rich stereo sound. From the crisp highs of the flutes to the tooth-rattling bass of the kettle drums, the music was crystal-clear and powerful. I could distinguish the distinct sounds from each individual musician, and as the orchestra reached the finale I almost fell out of my seat from the awesome force of the music. As the music faded, I leaned forward and hit a button on the stereo clock radio. I had a concert to go to that night—it was time to check the weather.

Ultimate sound machine. Zenith Audio has developed a Digital Stereo Clock Radio that boasts the acoustic quality and practical features of stereo radios four times as expensive. You'll be amazed at the sound quality and powerful bass you get from a radio this small and this affordable. This stereo radio features an 11-key handheld remote control and an input jack for CD players or other audio sources.

The best bass. Many small stereo radios can sound tiny and weak. This unit has an exclusive EXB button for expanded bass performance. It intensifies the lower tones for CD or FM stations, giving you rich, full and powerful stereo sound. If you want to listen to the stereo in private, there is a headphone jack on the side of the unit.

Compact Speakers with a Big Sound



The Zenith Audio Clock Radio has an exclusive EXB button for expanded bass performance. It intensifies the lower tones for CD or FM stations, giving you rich, full and powerful stereo sound.



Micro-Electronic Sound Breakthrough

State of the art stereo sound quality in a stylish cabinet

- | | |
|---|---|
| AM/FM/TV Bands | Ascending Tone Alarm |
| Stereo Speakers with Crystal Sound System | Wake/Sleep to Radio, Weather or TV Band |
| Digital Weather Band | "Fail-safe" Alarm System |
| 37 Preset Station Memories | |

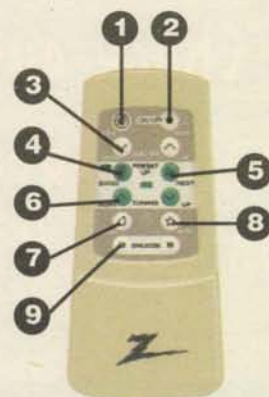
Loaded with features. You won't find a tabletop stereo with more added options. The AM/FM radio features digital tuning for pinpoint reception and crystal-clear sound. The STEREO indicator allows you to tune in to the stereo signal. It also picks up TV and WEATHER signals with 13 TV channels and 7 Weather channels, so your Zenith Audio Clock Radio is a great source of news, entertainment and information. You can program the unit's memory for 37 preset stations, and the tuning buttons can operate either manually or in an automatic search mode.

Practical functions. The backlit clock has several alarm functions, so you can wake to either radio, TV, weather or a buzzer. The sleep timer allows you to fall asleep to up to 90 minutes of music, TV or weather and then shuts off automatically. In the morning, if you need a few extra minutes of sleep, press the SNOOZE bar on the control panel or on the remote. The radio or alarm tone stops for 10 minutes and then sounds again. The process can be repeated several times as required. The unit's battery backup system will maintain the time, alarm and preset station memories in the event of a temporary power interruption. There is even a low battery indicator so you'll never oversleep in the event of a power failure.

Factory direct risk-free offer.

You can spend hundreds of dollars more on a stereo radio, but why do it? We get the Stereo Clock Radio direct from Zenith Audio and pass the savings on to you. This product comes with a one-year manufacturer's limited warranty and Comtrad's exclusive risk-free home trial. If you are not satisfied for any reason, simply return it within 90 days for a full "No Questions Asked" refund.

- 1 Mute
- 2 Power
- 3 Volume
- 4 Band
- 5 Preset
- 6 Tuning
- 7 Alarm
- 8 Sleep
- 9 Snooze



11-key full function remote works up to 15 feet away.

The Zenith Crystal Clear Stereo comes in white or black.



Zenith Crystal Clear Stereo \$99.95 \$12 S&H
Please specify white or black.

Please mention promotional code 4244-14637

For fastest service, call toll-free 24 hours a day

800-992-2966



To order by mail, send check or money order for the total amount including S&H. To charge it to your credit card, enclose your account number and expiration date.

Virginia residents only—please include 4.5% sales tax.



comtrad industries

2820 Waterford Lake Dr., Suite 102
Midlothian, Virginia 23113

Contents



*John Doggett wins
with Nuts & Volts!*

See page 54 for details!!

Check out
Santa's Special
on page 97!!



DEPARTMENTS

ADVERTISER'S INDEX	70
CLASSIFIED AD INFO	70
DEALER DIRECTORY	67
EVENTS CALENDAR	24
NEW PRODUCT NEWS	4
NEWS BYTES	36
NV ADMART	68-69
READER FEEDBACK	11
TECH FORUM	42

CLASSIFIED AD INDEX

10. Ham Gear for Sale	45	125. Microcontrollers	57
20. Ham Gear Wanted	45	130. Antique Electronics	57
30. CB/Scanners	45	135. Aviation Electronics	58
40. Music & Accessories	46	140. Publications	58
50. Computer Hardware	46	145. Robotics	58
60. Computer Software	48	150. Plans/Kits/Schematics	59
70. Computer Equip. Wanted	48	155. Manuals/Schematics	
80. Test Equipment	48	Wanted	60
85. Security	51	160. Misc. Electronics For Sale	60
90. Satellite Equipment	52	170. Misc. Electronics Wanted	61
95. Military Surplus Electronics	53	175. BBS & Online Services	63
100. Audio/Video/Laser	53	180. Education	63
110. Cable TV	54	190. Business Opportunities	63
115. Telephone/Fax	56	200. Repairs/Services	63
120. Components	56		

Nuts & Volts Magazine is published monthly for \$19.00 per year by T&L Publications, Inc., 430 Princeland Court, Corona, CA. POSTMASTER: Send address changes to Nuts & Volts Magazine, 430 Princeland Court, Corona, CA 91719.

ARTICLES

THE COMPUTER CONTROLLED WORLD Ryan Sheldon	8
Serial Killers: Gain a better understanding of RS-232 serial capabilities and limitations.	
A NEW USE FOR AN OLD SWITCH Chuck Baird	12
Get a "line" on how to keep your phone, fax, answer machine, Internet, and modem calls straight.	
PROGRAMMING A MICROCHIP PIC Chuck Hellebuyck	14
Discover four unique programmer packages to get you started programming PICs.	
ELECTRONIC CIRCUIT SYMBOLS & NOTATIONS Ray Marston	27
Take a look at some controversial aspects of modern circuit symbology.	
BUILD AN AIR JOYSTICK Mark Hanslip	38
Construct this one-handed joystick for use with your Sega Genesis game machine.	
BUILD A SEGA CONTROLLER TESTER Mark Hanslip	40
Streamline your repair time with this easy-to-construct tester.	
SECRETS OF MAKING ATTRACTIVE RACK PANELS Thomas Henry	72
Follow these practical techniques to make your homebrew projects look fabulous.	
RECOVERY AND REFINING OF GOLD FROM SCRAP ELECTRONICS Michael E. Young	82
Learn how to recover gold on a small scale in your own "backyard."	
A LICENSE FOR MAKING MONEY Gordon West	92
How would you like to earn \$1,000.00 a day by conducting ship radio station inspections aboard commercial boats required by law to carry marine radio equipment? Read on ...	
TEST LEADS Gerald Roylance	94
It's pretty hard to get excited about a bunch of low-tech wires, but when you don't have the right ones, it can lead to all kinds of clumsy connections.	

COLUMNS

AMATEUR ROBOTICS NOTEBOOK Robert Nansel	85
The benefits of learning how to program in machine language, tidbits on better ways to bend wires, and where to look for technical inspiration.	
ELECTRONICS Q & A TJ Byers	18
OPEN CHANNEL Joseph J. Carr K4IPV	77
Antenna gain and pattern measurement.	
RESOURCE BIN Don Lancaster	33
Fun with some neat stuff. A review of miscellaneous electronic goodies and high tech toys.	
STAMP APPLICATIONS	
Stamp Applications will be back next month hosted by a new columnist ...	

Nuts & Volts Magazine encourages article submissions and queries. Send a SASE for a copy of our writer's guidelines. All submissions should be on 5-1/4 or 3-1/2 inch diskettes and include hard copy as well. If return of materials is requested, include a SASE with your submission.

Deadlines should be discussed in advance with the editor, but generally all material should be submitted two weeks prior to the 1st of the month for the next month's issue.

Published Monthly By
T & L Publications, Inc.
 430 Princeland Court
 Corona, CA 91719
 (909) 371-8497
 FAX (909) 371-3052

E-Mail
 editor@nutsvolts.com
URL
 http://www.nutsvolts.com

Subscription
Order ONLY Line
1-800-783-4624

Publisher
 Jack Lemieux *N6ZTD*
 —
Editor
 Larry Lemieux *KD6UWV*
 —
Managing Editor
 Robin Nelson *KD6UWS*

—
On-The-Road Exhibit
Coordinator
 Audrey Lemieux *N6VXW*

—
Subscriptions
 Abby Madain

—
Classified Ads
 Natalie Sigafus

—
 Copyright 1998
 by **T & L Publications, Inc.**
 All Rights Reserved

All advertising is subject to publisher's approval. We are not responsible for mistakes, misprints or typographical errors. Nuts & Volts Magazine assumes no responsibility for the availability or condition of advertised items or for the honesty of the advertiser. The publisher makes no claims for the legality of any item advertised in Nuts & Volts. This is the sole responsibility of the advertiser. Advertisers and their agencies agree to indemnify and protect the publisher from any and all claims, action or expense arising from advertising placed in Nuts & Volts. Please send all subscription orders, correspondence, UPS, overnight mail and artwork to: 430 Princeland Court, Corona, CA 91719.

The closing date for each issue is the 5th of the prior month, e.g., the closing date for the June issue is May 5th. Ad copy to be typeset by Nuts & Volts should be received one week prior to the closing date. Call or write for current advertising rates.

CHANGE OF ADDRESS

If you are moving, notify us AS SOON AS POSSIBLE so we can continue your subscription without interruption.

Your magazine **WILL NOT** automatically be forwarded to you by the post office, so it's important to submit your change of address directly to Nuts & Volts. We will not be able to replace missed issues of the magazine due to unreported address changes.

When you send in your new address, include a current mailing label from the magazine with your account number on it. If you do not have a mailing label, be sure to include your old address and the name(s) under which the subscription was submitted.

**DON'T MISS
 A SINGLE
 ISSUE!!
 SUBSCRIBE
 TODAY!!**

To Subscribe to NUTS & VOLTS

USA ONLY

\$19.00 — 1 Year \$35.00 — 2 Years \$51.00 — 3 Years

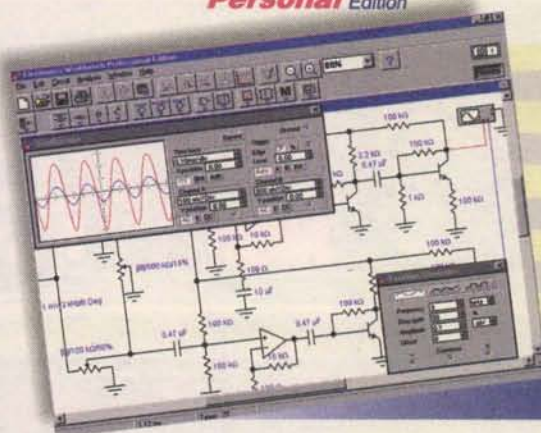
MAILED FIRST CLASS — FOREIGN ONLY

\$37.00 — Canada/Mexico \$100.00 — Foreign/Air Mail
 \$50.00 — Foreign/Surface

Send payment to the address below or call 1-800-783-4624
 and use your Visa or MasterCard.
Nuts & Volts Magazine, 430 Princeland Court, Corona, CA 91719

**THE WORLD'S MOST POPULAR
 DESIGN TOOL CHOSEN BY OVER
 100,000 USERS!**

Electronics Workbench[®] Personal Edition



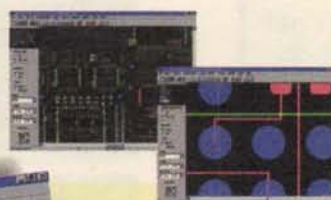
TRUE MIXED ANALOG/DIGITAL
 FULLY INTERACTIVE SIMULATION
 PRO SCHEMATIC EDITOR
 6 VIRTUAL INSTRUMENTS
 ON-SCREEN GRAPHS
 OVER 4,000 MODELS
 8 POWERFUL ANALYSES
 FREE TECHNICAL SUPPORT

\$299

Full-featured schematic capture and SPICE circuit simulation!

The world's most popular circuit design tool that sets the standard for powerful, insightful SPICE simulation. Create professional looking schematics and then with the flick of a switch, display simulated waveforms live on a suite of virtual instruments. Includes 15 powerful analyses and a library of over 4,000 robust component models.

Electronics Workbench[®] Layout Personal Edition



AUTOROUTING
 REROUTE WHILE MOVE
 32 ROUTING LAYERS
 50" X 50" BOARD SIZE
 OVER 3,500 LIBRARY SHAPES
 EXTENSIVE OUTPUT
 REAL TIME DESIGN RULE CHECK
 DENSITY HISTOGRAMS
 FREE TECHNICAL SUPPORT

\$299

Power-packed PCB layout with autorouting and real-time DRC!

EWB Layout is a powerful board layout package for producing high-quality, multi-layer printed circuit boards. Offering tight integration with our schematic capture program, EWB Layout is the best way to quickly produce well-designed boards.



BUY BOTH AND SAVE! ~~\$598~~ \$548

**CALL FOR INFORMATION
 AND PRICING ON OUR
 PROFESSIONAL EDITION.**

800.263.5552

30-DAY MONEY-BACK GUARANTEE

Fax: 416-977-1818

E-mail: ewb@interactiv.com



For a free demo, visit our website at **www.electronicworkbench.com**

Serial

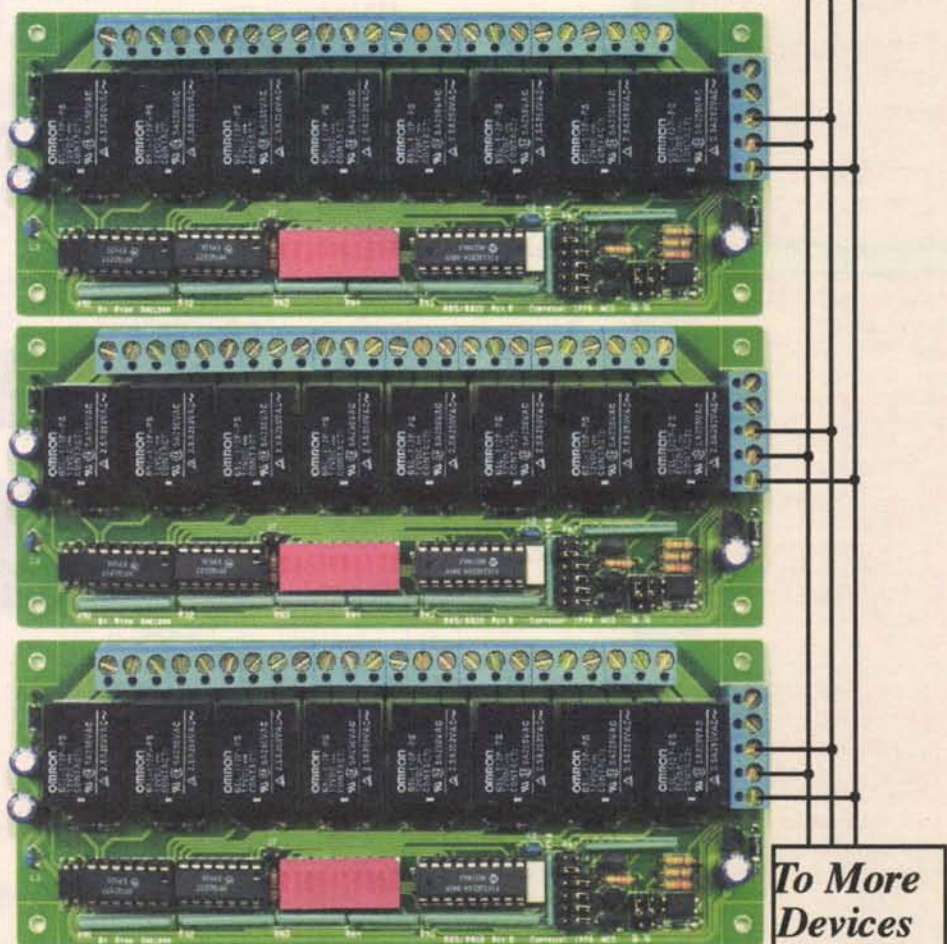
by Ryan Sheldon, National Control Devices (404) 244-2432 <http://members.aol.com/ncdcat>

Killers

FIGURE 1

RSB Serial Booster

Relay Drivers 1, 2, & 3.



Last month, I talked about controlling relays, graphic LCD displays, and A/Ds from a single serial port. While these are popular topics, I have received a large number of questions pertaining to general RS-232 communications. I want to clarify a few things in this month's article in hopes that readers get a better idea of RS-232 serial capabilities and limitations. In effect, I want my readers to know what inhibits (or kills) serial communications.

I will use the relay driver as an example to help clarify the questions I have received. Since this device is easy to program, readers will be able to concentrate on software and electrical issues rather than schematics and hardware. The relay drivers shown in this article will literally show you communication errors. By that, I mean corrupt data will usually appear as an unexpected relay activation/deactivation during a serial transmission.

How Far?

Perhaps the biggest question that I get with regard to RS-232 communications is distance. How far can you go? Well, there is no universal answer to this question. Some RS-32 peripheral devices may not operate beyond 12 feet, others may operate perfectly at a thousand feet. Distance is limited by four things:

- 1) Power: How powerful the port drivers are in your computer and attached device.
- 2) Speed: How fast you need to send and receive data.
- 3) Wire: Type of wire being used for communication.
- 4) Load: How much power is taken from the serial port from a driven device.

Power

The "RS" in RS-232 stands for "Recommended Standard" and, as such, is employed loosely by many computer manufacturers. While most desktop systems provide a powerful RS-232 signal (± 10 to 12 volts at 3mA), many laptops make use of low-power circuitry that usually compromises communications strength (usually ± 8 to 12 volts at 1mA).

Some microcontrollers (including the

Basic Stamp and some of our own devices) conform to the RS-232 timing standard only. So instead of generating a ± 12 volt signal, a standard logic-level (0/+5 volt) signal is used. A logic level RS-232 signal is not very powerful and should not be used for communicating data back to the computer beyond 10 feet. Without exception, all tested IBM-compatible PCs are capable of receiving logic level data without any problems. However, Macintosh systems require a true RS-232 signal for all

inbound communications.

Speed

Another very important factor in RS-232 communications is speed (baud rate). The faster you send data out your serial port, the shorter the communication distance. At high baud rates, data pulses are very short and become very susceptible to noise. At low baud rates, an RS-232 signal can travel great

distances. For example, I have tested 9600 baud over a distance of 1,000 feet with excellent results. Similar tests showed communications limitations of 60 feet at 115,200 baud.

Wire

Wire plays a very important role in RS-232 communications. I recommend the use of stranded insulated copper wire for best results. An average to heavy gauge (such as 12 or 10) is preferred. What you want to avoid is resistive and capacitive wire such as COAX and most stranded telephone cables.

Just keep in mind that anything that is capacitive corrupts data pulses by turning square waves into jagged waves. Resistive wire tends to weaken the signal strength. COAX is both resistive and capacitive, making it impossible to use for data communications unless used in combination with RF transceiver circuits such as those found in ethernet (thin-net) networking cards and hubs.

I have used stranded 15 gauge copper with good results, but would recommend a heavier wire if available. Solid copper telephone wire also works well and is often used by many readers in industrial installations.

Load

Say you have 12 light bulbs you want to power from a single battery. You attach the first bulb and the light is very bright. You attach the second bulb, and the first light gets a little dimmer, but both light brightly. As you keep attaching bulbs, the previously attached lights keep getting a little dimmer. The light bulbs are your load, and you may drive a few light bulbs at an acceptable brightness.

RS-232 communications suffers from the same problem. Except the RS-232 port is your battery and the device you want to drive is your light bulb. As you keep attaching devices to the serial port, the output power becomes weaker and weaker, until finally, the signal is corrupt and data can no longer control any device with reliability.

This scenario is more real than you might think. Many devices such as the relay controller discussed later in this article are optoisolated. In other words, they each have an invisible light bulb (LED) attached to the serial port used to protect the computer and

the device from each other in the event of an electrical malfunction. LEDs will load down an RS-232 port, as well as a logic-level data signal from a BASIC Stamp. Though not recommended, a BASIC Stamp can usually drive five optoisolators from a single output pin without problems. Beyond that, the signal MUST be boosted.

RS-232 Network Solutions

Since RS-232 standards are employed randomly from manufacturer to manufacturer, and since our application requires speed, distance, and heavy loading, a supplemental circuit must be used to provide the necessary communications power.

The RSB serial booster shown in Figure 1 delivers high-current -3/+12 volt data at speeds up to 38.4K. The RSB can deliver data to 20 optoisolated devices and has been tested over a distance of 1,000 feet. The RSB is equipped with a DB-25 female connector for direct connection to your computer. You will need to supply a minimum of 15 volts to properly power the board.

The RSB has a simple three-terminal connector labeled IN, GND, and OUT. The ground is shared with the RS-232 ground of all networked devices. The OUT delivers high-current data to all attached devices. The IN connector accepts open collector data (which is equivalent to high-speed switch closures to ground) and converts it back into a compatible RS-232 data signal. This allows up to 16 devices to share a three-wire interface. Simply add devices as needed by chaining them together from this three-wire interface.

Protocol

Now that data has been fed to all three relay drivers, you can now speak to each driver board individually by using a very simple addressing system. To understand this system, you have to know that your computer is capable of sending ASCII characters 0 to 255 out the serial port.

Each relay driver board listens to a user-defined set of 16 ASCII characters. For instance, relay dri-

ASCII Character	Action	Special Notes
0	Turn Off Relay 1 on Relay Board 1	ASCII Characters 0 to 15 Control Relay Driver Board #1. Jumpers J1-J4 Should All Be Removed.
1	Turn Off Relay 2 on Relay Board 1	
2	Turn Off Relay 3 on Relay Board 1	
3	Turn Off Relay 4 on Relay Board 1	
4	Turn Off Relay 5 on Relay Board 1	
5	Turn Off Relay 6 on Relay Board 1	Send Command 3 Times to Turn Off Relay 8 AND Report Status of all 8 Relays.
6	Turn Off Relay 7 on Relay Board 1	
7	Turn Off Relay 8 on Relay Board 1	
8	Turn On Relay 1 on Relay Board 1	
9	Turn On Relay 2 on Relay Board 1	
10	Turn On Relay 3 on Relay Board 1	Send Command 3 Times to Turn On Relay 8 AND Report Status of all 8 Relays.
11	Turn On Relay 4 on Relay Board 1	
12	Turn On Relay 5 on Relay Board 1	
13	Turn On Relay 6 on Relay Board 1	
14	Turn On Relay 7 on Relay Board 1	
15	Turn On Relay 8 on Relay Board 1	

FIGURE 2

ASCII Character	Action	Special Notes
16	Turn Off Relay 1 on Relay Board 2	ASCII Characters 16 to 31 Control Relay Driver Board #2. Jumpers J1 Should Be Installed, J2-J4 Should Be Removed.
17	Turn Off Relay 2 on Relay Board 2	
18	Turn Off Relay 3 on Relay Board 2	
19	Turn Off Relay 4 on Relay Board 2	
20	Turn Off Relay 5 on Relay Board 2	
21	Turn Off Relay 6 on Relay Board 2	Send Command 3 Times to Turn Off Relay 8 AND Report Status of all 8 Relays.
22	Turn Off Relay 7 on Relay Board 2	
23	Turn Off Relay 8 on Relay Board 2	
24	Turn On Relay 1 on Relay Board 2	
25	Turn On Relay 2 on Relay Board 2	
26	Turn On Relay 3 on Relay Board 2	Send Command 3 Times to Turn On Relay 8 AND Report Status of all 8 Relays.
27	Turn On Relay 4 on Relay Board 2	
28	Turn On Relay 5 on Relay Board 2	
29	Turn On Relay 6 on Relay Board 2	
30	Turn On Relay 7 on Relay Board 2	
31	Turn On Relay 8 on Relay Board 2	

FIGURE 3

ASCII Character	Action	Special Notes
32	Turn Off Relay 1 on Relay Board 3	ASCII Characters 32 to 47 Control Relay Driver Board #3. Jumpers J2 Should Be Installed, J1, J3, and J4 Should Be Removed.
33	Turn Off Relay 2 on Relay Board 3	
34	Turn Off Relay 3 on Relay Board 3	
35	Turn Off Relay 4 on Relay Board 3	
36	Turn Off Relay 5 on Relay Board 3	
37	Turn Off Relay 6 on Relay Board 3	Send Command 3 Times to Turn Off Relay 8 AND Report Status of all 8 Relays.
38	Turn Off Relay 7 on Relay Board 3	
39	Turn Off Relay 8 on Relay Board 3	
40	Turn On Relay 1 on Relay Board 3	
41	Turn On Relay 2 on Relay Board 3	
42	Turn On Relay 3 on Relay Board 3	Send Command 3 Times to Turn On Relay 8 AND Report Status of all 8 Relays.
43	Turn On Relay 4 on Relay Board 3	
44	Turn On Relay 5 on Relay Board 3	
45	Turn On Relay 6 on Relay Board 3	
46	Turn On Relay 7 on Relay Board 3	
47	Turn On Relay 8 on Relay Board 3	

FIGURE 4

ver board #1 listens to ASCII characters 0 to 15. Relay driver board #2 listens to ASCII characters 16 to 31. Relay driver board #3 listens to ASCII characters 32 to 47. A set of four jumpers (J1-J4) defines which set of ASCII characters the relay driver board will respond to. See Figures 2, 3, and 4 for complete details on controlling each device.

ASCII Characters

One quick note worth mentioning about ASCII characters: ASCII characters are sent using their character codes. For example, the ASCII character "A" is sent using the ASCII character code 65. It is much easier to send

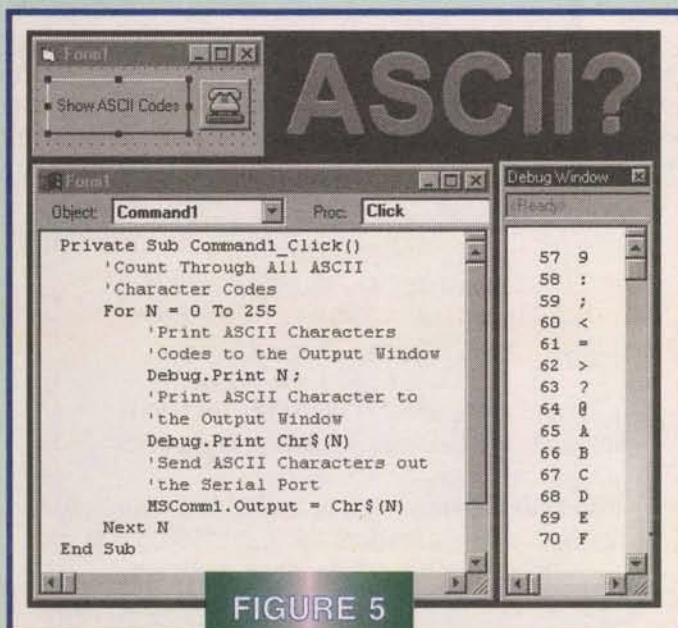


FIGURE 5

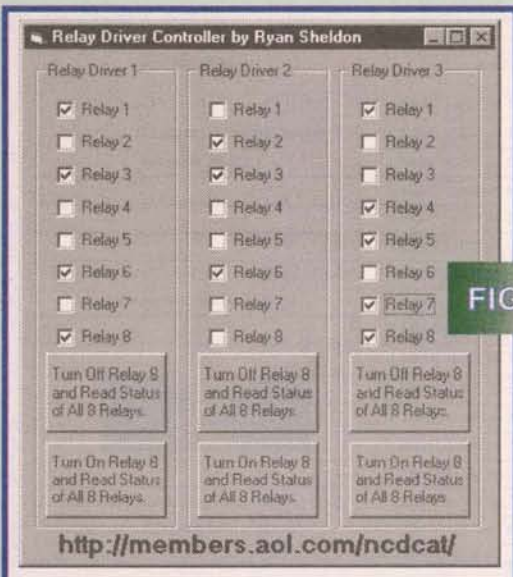


FIGURE 6

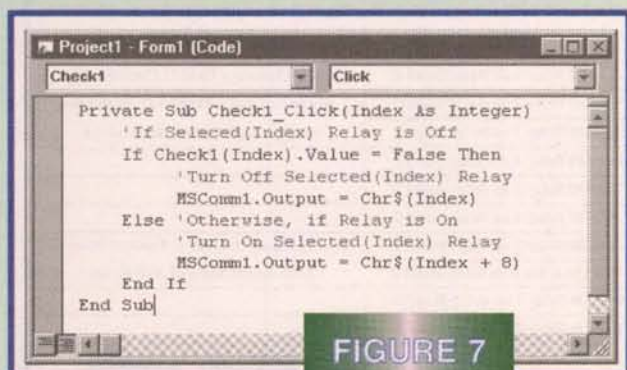


FIGURE 7

the ASCII character codes (number 0 to 255) than it is to send the actual letters and numbers. Figure 5 demonstrates a quick program that lets you see the difference between ASCII characters and character codes. The demo program also shows how to send these codes out the serial port by making use of the MSComm Control under Visual Basic 5 Professional.

Controlling Relays

The RS-232 relay drivers shown in Figure 1 were designed for ease of use and simple troubleshooting. When properly powered, the heartbeat LED will begin flashing. The heartbeat LED indicates that power is properly applied and that the microprocessor is operating correctly.

As data is received, the "Data Received" LED will flash. This LED flashes any time data is detected on the serial port, regardless of which device the data is speaking to. This LED will flash on all three relay drivers during ANY data transmission.

The relay drivers shown in this article can be operated at 1200, 9600, and 19.2K baud (two stop bits at 19.2K baud) making them easy to interface to just about any computer or microcontroller. As control characters are received, you will hear the relays click on and off. A status LED will also indicate the on/off state of each relay on each board.

Figure 6 illustrates a simple program that I have written to control each of the three relay drivers from a Visual Basic application. Figure 7 shows just how easy it is to control these relay drivers. When a check mark box is clicked, this short program evaluates which box was clicked and the current status. This routine then sends an appropriate ASCII character out the serial port using the MSComm control.

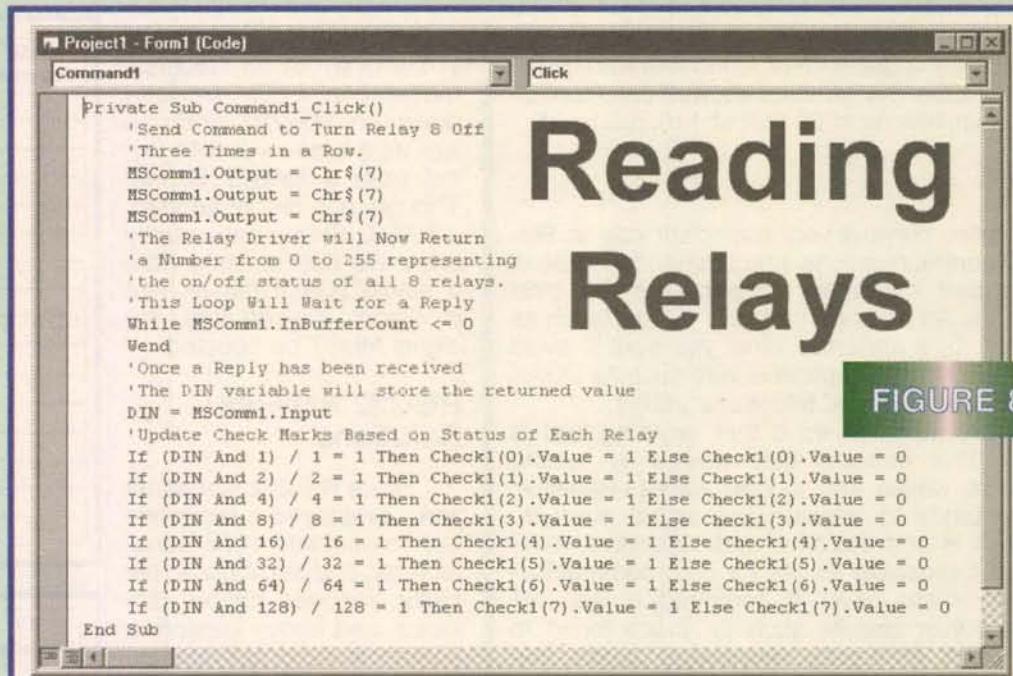


FIGURE 8

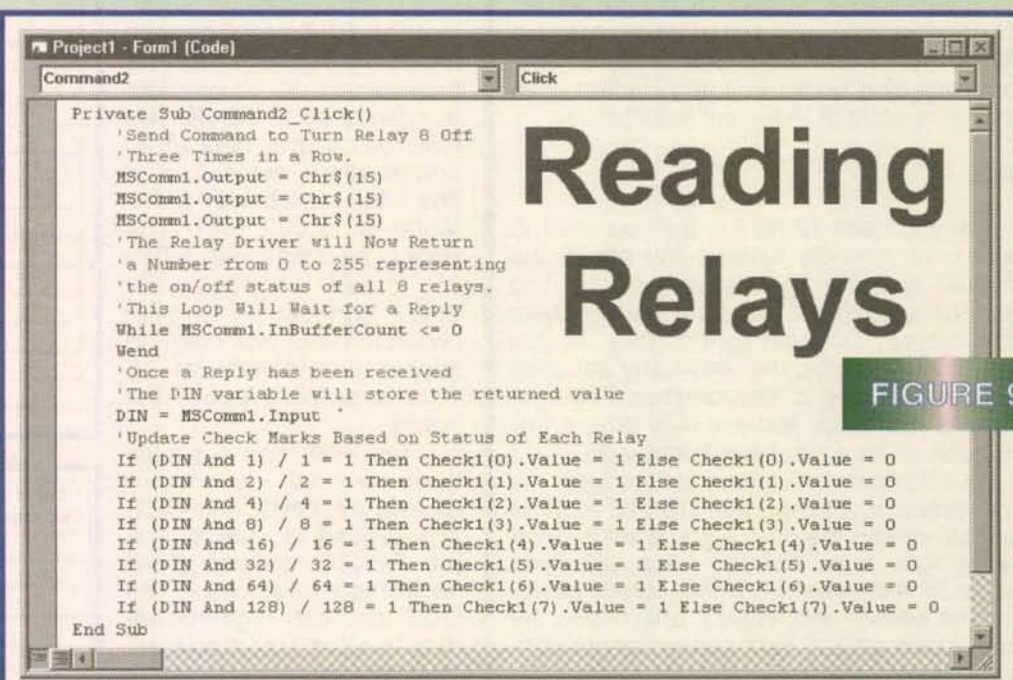


FIGURE 9

Up to 16 relay controllers may be driven from a single RS-232 serial port. Each relay controller can report the status of the eight relays by sending the command to turn relay 8 on or off three times. This function is convenient for industrial applications that may require rock-solid reliable two-way communications.

Figures 8 and 9 show example code for reading the status of all eight relays. The read function requires that you send the command to speak to relay 8 three times in a row. Once issued, the relay controller will return a byte from 0 to 255. A 0 indicates all relays are off. A 255 indicates all relays are on. Any number in between represents the binary status of the relays. The final portion of this subroutine updates the check boxes providing a visual on-screen display of the current relay status.

Relay drivers have found their way into many control applications. They have been used to control lights, motors, speakers, sprinkler systems, alarm systems, and even explosives on many movie sets. Since it is easy to determine the on/off state of the relays

from a remote location, many industrial users have been able to use them in a variety of manufacturing installations. Surprisingly, these relay controllers are most commonly used in factories that are in the process of automating old manufacturing equipment by adding centralized remote operation.

Thanks again for reading this month's "Computer Controlled World," and don't hesitate to call me at (404) 244-2432 or write me at ncdryan@aol.com if you have any questions. **NV**

Boards and Chips Available

Contact Ryan Sheldon
National Control Devices

Phone: (404) 244-2432

Fax: (417) 646-8302

E-Mail: NCDRyan@aol.com

<http://members.aol.com/ncdcat/>

The LCD Animator 128 is available exclusively to Nuts & Volts readers for just \$199.00 if you mention this article when ordering.

reader FeedBack

Dear Nuts & Volts:

Regarding question #10982. Probably it is true that "blocking the unknowns with your Caller ID box is a very bad idea." But the question asked was "How" to do it, not whether sending a message to calls that come in identified only as "unknown."

What you get from a Caller ID modem is a text string. How you respond to it depends on how you interpret the text. Your Bel-Tronics box obviously sees "blocked" and responds "blah." All you have to do is recognize "unknown" and respond "blah." Yes, it's easier said than done, since probably you have no access to the Bel-Tronics innards. So, you call Terry Weeder 850-863-5723 and order his Caller ID interface kit.

This device will get the text string into your PC via the serial port. You get an old DOS box and write some QBASIC code to examine the text string for "unknown" or whatever, and respond to it in your own way, like dump a canned voice message on the line. It's called "systems inengineering" you've heard of it.

Jack Dennon
via Internet

Dear Nuts & Volts:

Answer correction to #9983 Sept. '98. When salt is dissolved in water it does not become more conductive, just the opposite. It creates a greater resistance thereby causing an increase in load on the power source.

As with any conductive material, as the temperature increases, the resistance decreases. All the meters giving a reading based on the voltage that is able to activate the meter. More resistance equals less voltage to the readout, less resistance equals more voltage to the readout.

A simple meter can be constructed with a six-volt lantern battery, a small voltmeter and two long pieces of copper wire (insulated w/ends bare).

Attach one connector of the meter to one post of the battery, one length of copper wire to the other connector on the meter. Connect the other length of copper wire to the other post of the battery. Place a known quantity of water in an insulated container. Place the bare ends of the copper wire in the container of water and note the voltage on the meter.

As you add and dissolve salt in the water, note that the voltage decreases. With a known quantity of water ratio to quantity of salt, one can translate the voltage reading to salinity in any known quantity of water wherein, there is an unknown quantity of salt. Keep in mind that other conductive solids in water will effect the meter readings.

Another simple method is to

use a resistance or ohmmeter to test a known quantity of pure water and as you add known quantities of salt, note the resistance readings. Make a schedule that shows the resistance reading at various known quantities of salt. Use this schedule to determine salinity of like amounts of water as test samples. Again, keeping in mind that other unknown dissolved conductive solids will effect the reading.

If one is testing seawater, the reading will give you more information concerning the other dissolved solids, as seawater is commonly 35,000ppm salt or approximately 3.5%. The water in the Great Salt Lake is so much greater than even seawater that is all but impossible to sink in it.

Jim West
Dale City, VA

Dear Nuts & Volts:

On page 17 of the Nov. '98 issue of *Nuts & Volts*, Emil Rosssdeutscher writes a letter about another potential Y2K problem. He is not quite correct, but he brings up, unintentionally, a different problem altogether.

Emil states that chips using a mod 4 method to determine leap years "[...] are an actual Y2K problem. They will tell you that the last year of the 20th Century is a Leap Year, which it is not." The truth is, 2000 will be a leap year, so these chips will function correctly after all.

The problem is, as you might guess, that some people know 2000 is a leap year and some don't. People writing software and making hardware may or may not know this, and may or may not make their systems obey the convention.

So January 1st is not the only day in 2000 that we should be concerned about.

Russ Perry, Jr.
Arlington Heights, IL

Dear Nuts & Volts:

In the Nov. '98 issue, there is a letter from Emil Rosssdeutscher about the year 2000 not being a leap year. Sorry, that is in error.

You see, there are three conditions to fulfill. First, the obvious one, that any year divisible by four is a leap year. Next, the exception.

Any century year is not a leap year. But, there is a third condition, an exception to the exception — that is, if a century year is divisible by 400, it is a leap year. This is to correct for the "overcorrection" in the century year rule. If you strictly adhere to that rule, you end up slightly short overall.

In other words, the year 2000 is indeed a leap year, despite being a century year.

Charles W. Shults III
Orlando, FL

SURPLUS TEST EQUIPMENT

HEWLETT PACKARD

11713A, Attenuator/Switch Driver	\$800
11729B, Carrier Noise Test Set	\$3500
11975A, Amplifier, 2-8GHz	\$2000
1662A, 68 Channel Logic Analyzer	\$2500
3310A, Function Generator	\$250
3312A, Function Generator, 1Hz-13MHz	\$700
3325A, Synthesizer/Function Generator	\$1000
3325A/01/02, Synthesizer/Function Generator	\$1500
3335A, Frequency Synthesizer, 200Hz-81MHz w/Opt. 01	\$5500
334A, Distortion Analyzer	\$250
339A, Distortion Analyzer	\$1200
3456A, Digital Multimeter, 6.5 Digits	\$800
3478A, Digital Multimeter	\$700
3488A, Switch Control	\$600
3551A, Transmission Test Set	\$600
3562A, Dynamic Signal Analyzer	\$7000
3575A, Phase Gain Meter 1Hz-13MHz	\$1000
3577A, Network Analyzer w/35677A Test Set	\$10,500
3581C, Selective Voltmeter	\$800
3585A, Spectrum Analyzer, 20Hz-40.1MHz	\$6000
3586B, Selective Level Meter	\$750
3586C, Selective Level Meter	\$700
4192A, LF Impedance Analyzer w/16097A Kit	\$12,000
4193A, Vector Impedance Meter	\$7500
4342A, Q-Meter	\$1800
435B, Power Meter	\$500
436A, Power Meter w/Opt. 022	\$1200
4815A, RF Vector Meter	\$1200
4935A, Transmission Impairment Test Set w/Opt. 001	\$1500
5314A/01/02, Universal Counter	\$225
5316B, Universal Counter	\$1000
5328B, Universal Counter	\$1000
5335A, Frequency Counter, Opt. 10/20	\$850
5340A, Frequency Counter, 10Hz-18GHz	\$800
5340A, Frequency Counter w/Opt. 01/02/011	\$1350
5342A, Microwave Frequency Counter, 10Hz-18GHz	\$1100
5350B, 20GHz Frequency Counter	\$3000
5355A, Frequency Converter	\$1000
5386A, Frequency Counter, 10Hz-3GHz	\$2000
54100A, Digitizing Oscilloscope	\$2500
54110D, 1GHz Color Digitizing Oscilloscope	\$2500
54120A, Digitizing Oscilloscope Mainframe	\$5750
54121A, Four Channel Test Set	\$6500
54201D, Digitizing Oscilloscope	\$2650
8011A, Pulse Generator	\$400
8011A, Pulse Generator w/Opt. 001	\$500
8012B, Pulse Generator	\$750
8013B, Pulse Generator	\$750
8112A, 50MHz Pulse Generator	\$4000
8116A, 50MHz Pulse/Function Generator, Opt. 001	\$4500
8165A/002, Programmable Signal Source w/AM	\$2200
8347A, RF Amplifier, 100KHz-3GHz	\$3000
8350A, Sweep Oscillator Mainframe	\$1500
8350B, Sweep Oscillator Mainframe	\$2350
83522A, Sweeper Plug-in, .01-2.4GHz, w/Opt. 02	\$4500
83540A, RF Plug-in, 2.0-8.4GHz	\$2000
83540A/002, RF Plug-in, 2-8.4GHz	\$2500
83545A, Oscillator Plug-in, 5.9-12.4GHz	\$1750
8411A/018, Frequency Converter, .11 to 18GHz	\$500
8494H, Programmable Attenuator (unused)	\$800
8495H, Programmable Attenuator (unused)	\$600
8501A, Storage Normalizer	\$1000
8505A, Network Analyzer w/8501A & 8503A	\$4000
8511A, Harmonic Frequency Counter	\$7000
8554B, RF Spectrum Analyzer Plug-in, 500KHz-1250MHz	\$800
8559A, Spectrum Analyzer Plug-in, .01-21GHz	\$2650
8566A/B, Spectrum Analyzer, 100Hz-22GHz	\$22,000
8568A/B, Spectrum Analyzer, 100Hz-1500MHz	\$7500
8568B, Spectrum Analyzer, 100Hz-1500MHz	\$10,000
8569B, Spectrum Analyzer, 10MHz-22GHz	\$7000
8640A, Signal Generator, 0.5-512MHz	\$2100
8640B, Signal Generator, Opt. 002, 5-1024MHz	\$700
8640B, Signal Generator, Opt. 1, 2	\$2200
8654A, Signal Generator, 10-520MHz	\$450
8656A, Signal Generator, 100KHz-990MHz	\$2000
8660D, Synthesized Signal Generator	\$7000
8672A, Synth. Signal Gen., 2.0-18.0GHz	\$7000
8748A, S-Parameter Test Set w/Opt. 026	\$1350
8753A, Network Analyzer w/85046 Test Set	\$12,000
8754A, Network Analyzer w/8748A Test Set	\$2000
8756A, Scalar Network Analyzer	\$1500
8757A, Scalar Network Analyzer, 10MHz-60GHz	\$4500
8901B, Modulation Analyzer	\$4000
8904A, Multifunction Synthesizer w/Opt. 002	\$2500
8970A, Noise Figure Meter	\$5000

TEKTRONIX

1502, TDR Cable Tester w/Opt. 04 Recorder	\$1700
1503, TDR Cable Tester w/Opt. 04 Recorder	\$1550

2215, 60MHz Oscilloscope	\$500
2236, 100MHz Oscilloscope w/Counter/Timer/DMM	\$1000
2246, 100MHz Oscilloscope	\$1600
2247A, 100MHz Oscilloscope w/Counter/Timer/Voltmeter	\$2500
2337, 100MHz Oscilloscope w/DMM	\$1650
2430A, 150MHz Digital Oscilloscope	\$2850
2432A, 300MHz Digital Storage Oscilloscope	\$3000
2445, Four Channel 150MHz Oscilloscope	\$1500
2445A, 150MHz Four Trace Oscilloscope	\$1850
2465, Four Channel 300MHz Oscilloscope	\$2500
2465B, Four Channel 400MHz Oscilloscope	\$4500
2754P, 10KHz-21GHz Spectrum Analyzer	\$9000
465B, 100MHz Oscilloscope	\$450
466, 100MHz Storage Oscilloscope w/DMM4	\$800
475, 200MHz Oscilloscope	\$650
475A, 250MHz Oscilloscope	\$800
485, Oscilloscope, 350MHz	\$900
494P, 10KHz-21GHz Spectrum Analyzer	\$10,000
576, Curve Tracer	\$2750
577/D2, Curve Tracer, Non-storage w/177 Fixture	\$1750
7D20, Programmable Digitizer	\$400
7L5/L3, Spectrum Analyzer, 20Hz-5MHz, w/Opt. 025 Tracking Generator	\$1850
7L12, Spectrum Analyzer, 100KHz-1.8GHz	\$1500
7L13, Spectrum Analyzer, 1KHz-1.8GHz	\$1800
7L18, Spectrum Analyzer Plug-in, 1.5-18GHz Capable of 60GHz with Mixers	\$2500
7S12, TDR/Sampler	\$450
AFG5101, Arbitrary Function Generator	\$1500
CG5001, Programmable Calibration Generator	\$4000
PG506, Calibration Generator Plug-in	\$600
R2246, 4 Channel Oscilloscope, 150MHz	\$1500
SG5010, Programmable Oscillator	\$3000

**VISIT OUR WEBPAGE AT
WWW.RSSURPLUS.COM**

SG504, Leveled Sinewave Generator	\$1800
TM5003, Three Slot Power Mainframe	\$450
TM5006, Six Slot Power Mainframe	\$550
TR503, Tracking Generator for 482/4/5/6	\$850

MISCELLANEOUS

Acme Elect. PS2L1000, Electronic Load	\$850
California Inst. 4500L/M3, AC Power Source	\$4000
California Inst. 4503L, AC Power Source	\$4000
Datron 1281, 8.5 Digit Multimeter w/Opt. 10/20/30/80	\$3250
Eaton 2052B, Amplifier, 100-512MHz	\$800
EIP 545A, Microwave Frequency Counter	\$800
EIP 548A, Frequency Counter, 10Hz-26.5GHz	\$2000
EIP 548B, Frequency Counter, 10Hz-26.5GHz	\$3250
EIP 578, Source Locking Frequency Counter	\$2500
ENI 1140LA, Power Amplifier, 9KHz-250KHz	\$3500
ENI 310L, RF Amplifier, 50dB, 250KHz-110MHz	\$2000
ENI 325LA, Power Amplifier, 250KHz-150MHz 25 Watts	\$1850
ENI 503L, RF Amplifier, 40dB, 2-510MHz	\$800
Fluke 5100B/03/05, Multifunction Calibrator	\$3000
Fluke 5101B/03, Calibrator	\$3000
Fluke 5200A, AC Voltage Calibrator	\$2000
Fluke 732A, DC Standard	\$1850
Gigatronix 910, Frequency Synthesizer, .05-26GHz	\$9500
Kikusui PAD16-10L, Power Supply, 16V, 10A	\$300
Kikusui PLZ700W, Electronic Load	\$850
Krohn-Hite 3202/R3202, Tunable Filter/Rack Version	\$500/\$350
LeCroy 9424, 350MHz Oscilloscope	\$3500
Marconi 2019A, Signal Gen., 80KHz-1040MHz	\$2200
Phillips 6652C, Prog. High Res. Counter/Timer, 8 Digit, 120MHz	\$1300
Phillips PM3394, 200MHz Oscilloscope	\$2250
Sorensen DCR300-33T, DC Power Supply 300V/33A	\$2750
Sorensen DCS40-25, DC Power Supply, 40V/25A	\$750
Trans. Devices DLR400 15 3500A, Dynamic Load	\$1500
Trans. Devices DLP 50-60-1000A, Electronic Load	\$800
Trans. Devices DLVP 130-110-1000 Electronic Load	\$950
Trans. Devices DLVP 50-120-1000 Electronic Load	\$1000
Vaihallia 2703, AC Voltage Standard	\$2350
Varian VZL6942G5JM, Amplifier, 1-2GHz, 100 Watt	\$8000
W & G SNA5, 50Hz-3.2GHz Spectrum Analyzer	\$6000
Wavetek 178, Automatic Synthesizer	\$1850
Wavetek 3000, Signal Generator, 1-520MHz	\$900
Wavetek 3000-200, Signal Generator	\$900
Wavetek 3001, Signal Generator 1-520MHz	\$1000
Wavetek 801, Pulse Generator, 5Hz-50MHz	\$800



R & S Surplus

1050 E. CYPRESS STREET, COVINA, CA 91724

(626) 967-0846 • FAX (626) 967-1999



A New Use for an Old Switch

I have used a PC fax/modem for several years and like the convenience of sending faxes directly from my word processor without having to print them. However, I have never been happy using the modem to receive faxes, both because it ties up the computer while the fax is coming in, and because it is necessary to leave the computer and fax software running whenever a fax might arrive. Given these reasons and the frequent need to send non-computer-generated documents, I finally bought a stand-alone fax machine.

Sharing a residential phone line with a fax machine can also be a minor pain, even with a "smart" switch (about \$80.00, more than I wanted to spend) that is supposed to recognize the type of an incoming call and route it appropriately. Add a second phone line (due to an Internet account and the desire to stay married) and the stage is set: manage two phone lines, a heavily used modem, an occasional out-bound fax via modem, in and out faxes on the stand-alone machine, and do it without using an automatic switch.

All this, plus honor the small print in the fax machine's manual: don't share the fax machine's phone line with a modem because they might try to sing duets during data transfers. Also, since a manual switch was my preference, it would be good to have some indicator lights to remind me to set everything back to "normal" any time

I changed it.

After pricing multiple pole, multiple throw switches, and not wanting to wait for mail order delivery, I decided to try to come up with an alternative solution. Looking through my junk box for possible switching components, I came across an old printer A/B box which was designed to allow one computer to use two printers or two computers to use one printer.

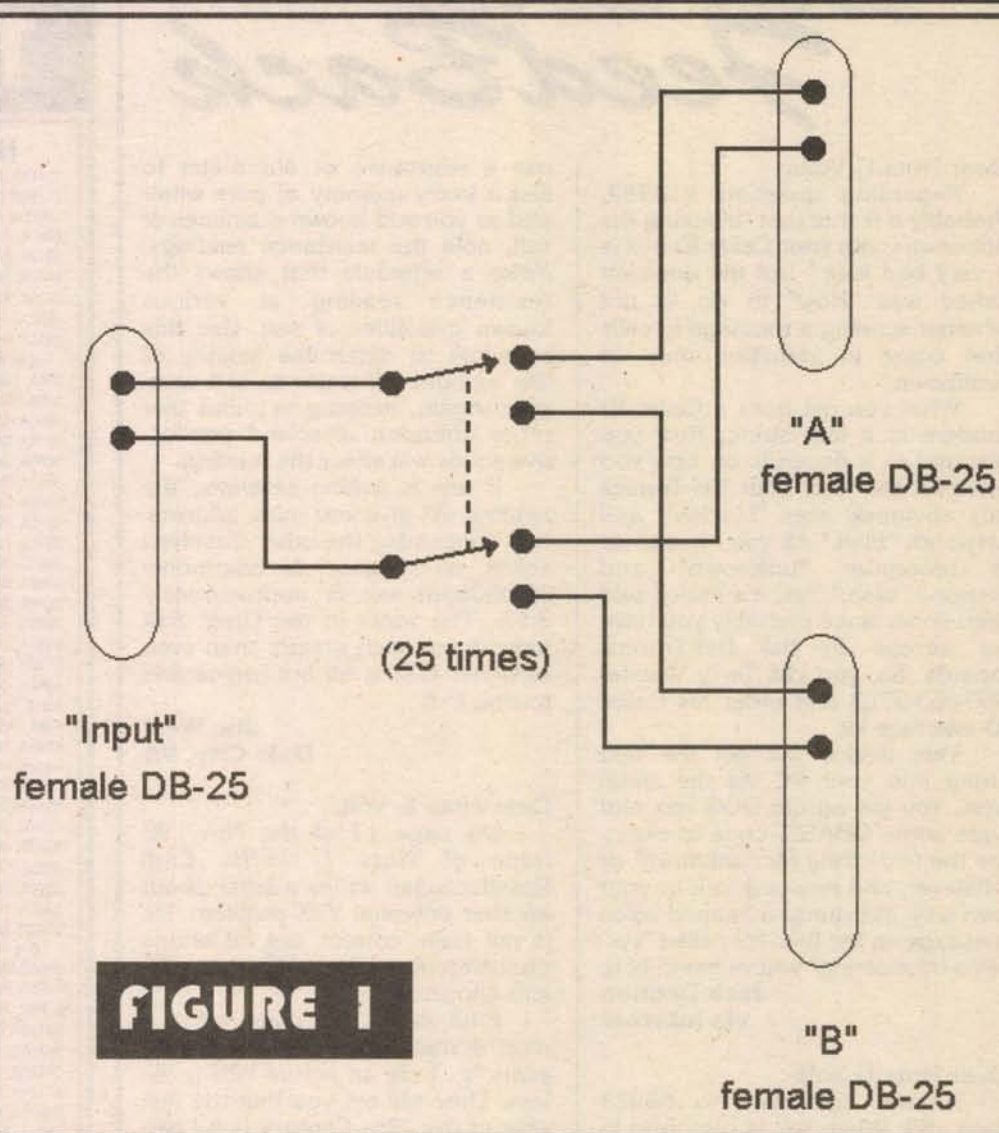


FIGURE 1

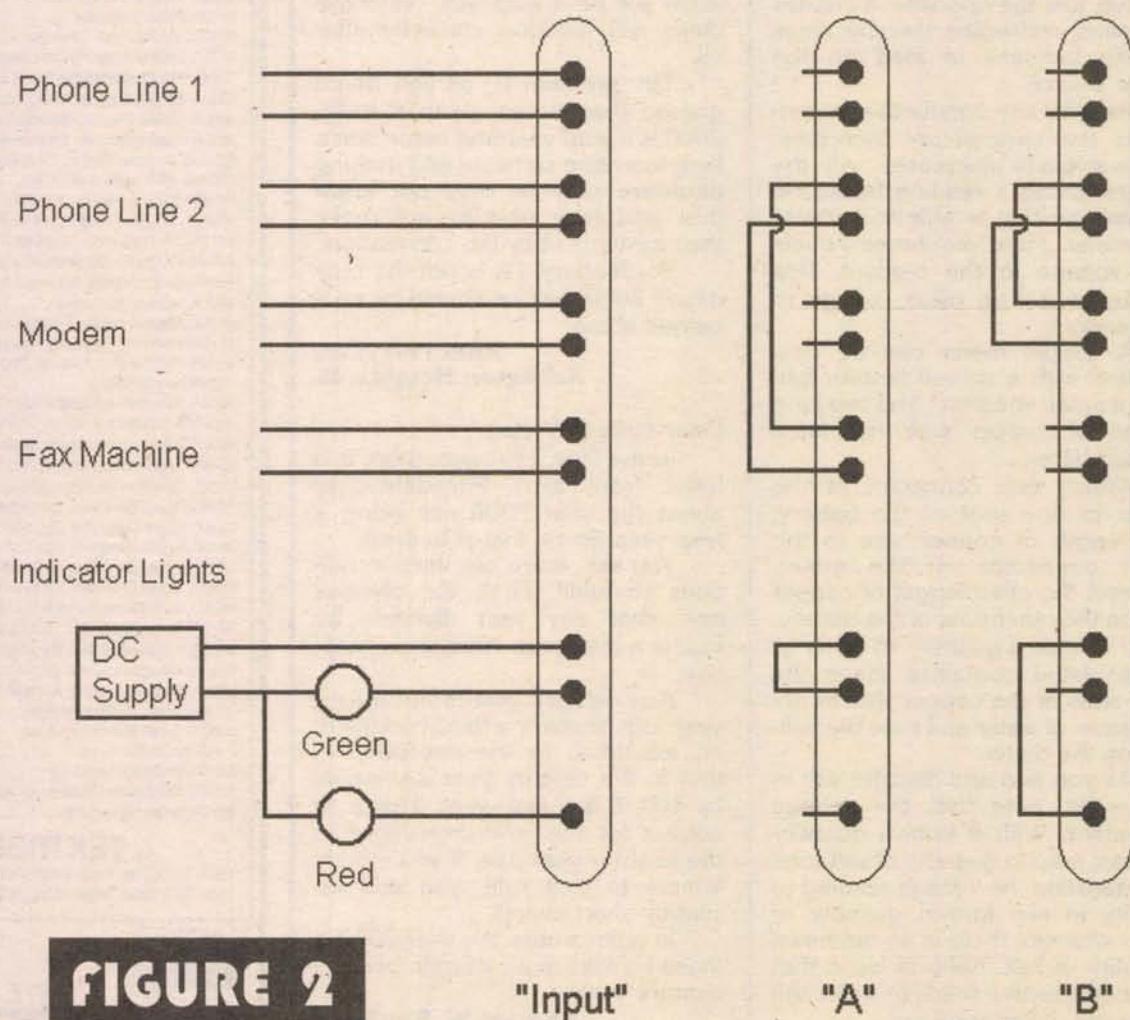


FIGURE 2

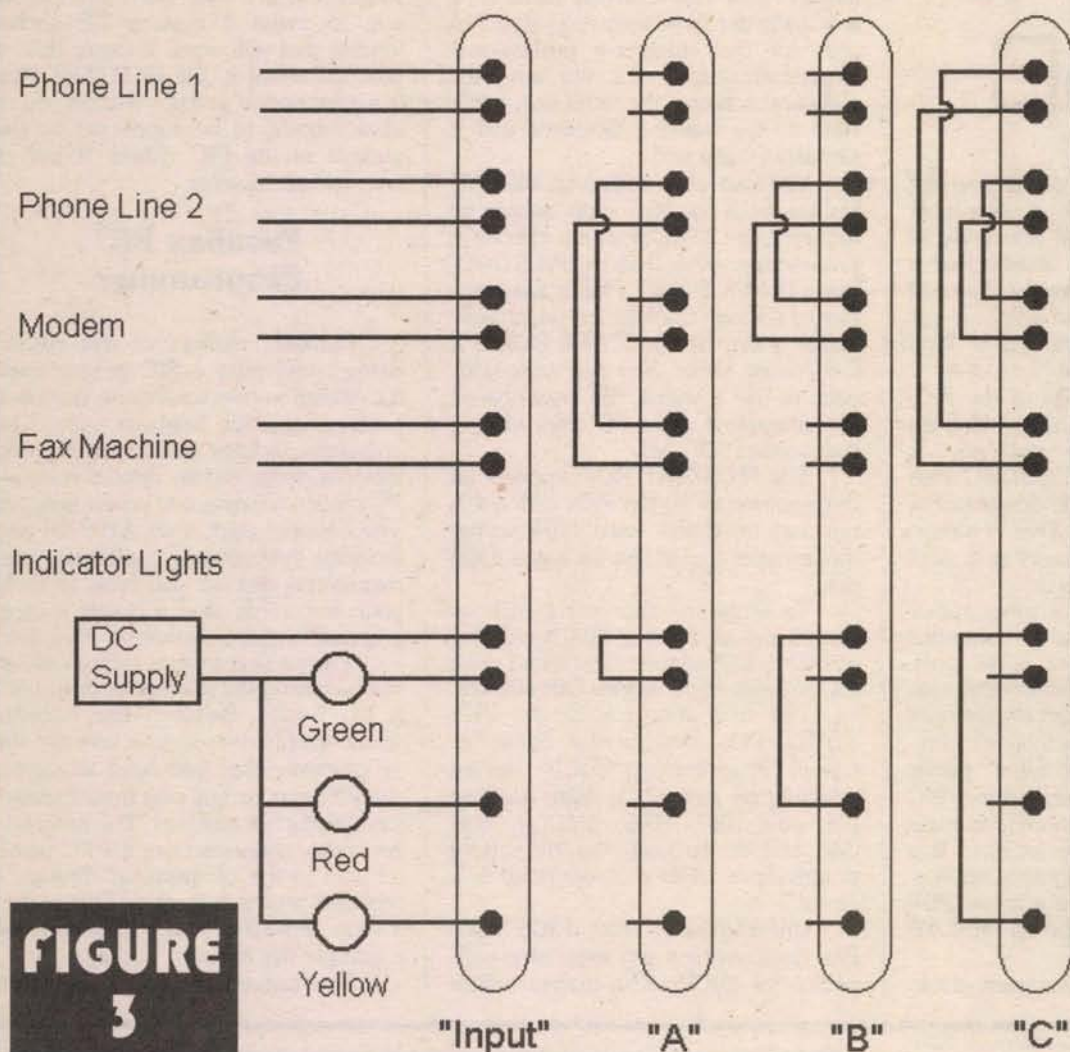


FIGURE 3

It consists of a 25-pole, double-throw switch in a case and had three female DB-25 connectors on the rear (input/A/B) and a two position switch (A/B) on the front (see Figure 1). As I was starting to cannibalize the switch for this project, it dawned on me that there was a much better way to utilize the A/B box.

Since there are 25 switched lines (some A/B boxes switch fewer, sometimes 24) and an inexpensive DB-25 connector on each end, I decided to use the set of 25 lines as a sort of bus. I connected the pairs of wires for each of the two outbound phone lines, the modem ("wall" jack), the fax machine ("wall" jack), and the indicator lights wiring to arbitrary pins of a male DB-25 and plugged it onto the "input" connector.

I then wired another DB-25 with jumpers which con-

nected these "bus" wires together in the desired combination and plugged it onto the "A" connector. When the switch is in the "A" position, this connector routes the inputs appropriately.

I wired a third male DB-25 with a different jumper arrangement and plugged it onto the "B" connector, and the project was done. Critical issues are using a DC source for the lamps and observing polarity of the phone lines throughout. See Figure 2.

In this arrangement, line one remains unswitched and goes to the various extension telephones and the answering machine elsewhere in the house. Line two switches between the fax machine and the modem, with a green light indicating the fax machine is able to receive calls (the normal state of things), and a red light meaning that faxes cannot be received. When I get off

of the Internet in the wee hours of the morning, the red light is supposed to remind me to flip the switch.

Later, I came across a surplus A/B/C printer switch box which I now use in place of the original A/B switch. They work the same, but the A/B/C switch uses a 25-pole, three-throw switch and has a third output connector and switch position. My previously wired connectors all work on it without modification, plus I now have an additional switch position which provides a third wiring arrangement. My current configuration is shown in Figure 3.

This wiring arrangement switches both phone lines. In the "A" position, extension phones are on line one, the fax machine is on line two, and the green light is on. In the "B" position, extension phones are on line one, the modem is on line two, and the red light is on. In the "C"

position, both extension phones and the fax machine are on line one, the modem is on line two, and the yellow light is on.

This third position allows me to send or receive a fax manually during a voice conversation on line one, as well as to exchange faxes between the modem and fax machine for testing, or to inspect print and scan quality. The reason for not having the fax machine on line one under normal conditions is to keep it from answering incoming voice calls.

I have found this solution works well, and the total new parts cost was four male DB-25 connectors at 39 cents each (optional hoods are considerably more expensive). I can also wire additional connectors at any time to reconfigure the switch. Furthermore, although I hope my shared printer days are over, the original A/B and A/B/C boxes are unmodified and as good as ever. **NV**

JFETS

ULTRA LOW NOISE
LS843 - 3nV/Hz typ

TIGHT MATCHING

LS843 - 1 mV max

- ♦ N & P Channel
- ♦ Duals & Singles
- ♦ Custom Screening
- ♦ Die, SMT, Thru-Hole
- ♦ No Order Minimum
- ♦ COD's Accepted

Second Source for Domestic
& Foreign JFETs & Bipolars

Full Service U.S. Manufacturer
of Specialty Linear Products

LINEAR SYSTEMS

4042 Clipper Court
Fremont, CA 94538
510-490-9160/510-353-0261(Fax)
E-mail: 3823671@MCIMAIL.COM

Write in 55 on Reader Service Card.

Programming a Microchip PIC

I'm probably safe in assuming that you've heard about the Microchip PIC microcontrollers. You may have surfed a few websites or read an article about them. You might have even used a BASIC Stamp and learned it is built around a Microchip PIC microcontroller. No matter what road you took to understand what a Microchip PIC is, at some point you'll want to get your hands on a PIC and actually program it.

To program a PIC requires a PIC part, a program, and a PIC programmer. Because Microchip PICs are so popular, you have many programmer options to choose from. To cover every option available would be impossible. Instead, I decided to focus on four programmer packages to get you started. From these, you should be able to guide yourself down the path that is right for you. Let's start at the top with Microchip.

Microchip PICSTART Plus

As the PICs have evolved, so have the programmers from Microchip. The

PICSTART Plus is Microchip's current "low-cost" offering for development work. It could be called affordable at \$199.00, but you can usually find a deal through Microchip that will let you buy it for \$149.00. Just keep an eye on their website or contact a local Microchip representative.

The main advantage to the PICSTART Plus is the support from Microchip. When any new part is released, free updated PICSTART Plus software is available for download at the Microchip website. This is important to me because Microchip is constantly releasing new parts.

The PICSTART Plus programmer is very easy to use and is controlled through your computer's serial port. The PICSTART Plus also comes with everything you need to get started right away (except a Windows-based computer). The serial port cable, power supply, and a 16F84 flash memory PIC that can be reprogrammed multiple times are included. Also included is a CD that has sample programs, application notes, data sheets in acrobat .PDF format, and the Microchip MPLAB simulator ready to install.

MPLAB is a great environment to

develop your PIC assembly code in. It is actually the same software Microchip uses for their high-cost professional emulation system. It's the emulator software without the emulator hardware so it's called a simulator and it simulates really well.

You can also download MPLAB for free from the Microchip website or request the CD-ROM if you choose a programmer other than the PICSTART Plus. The PICSTART Plus is fully supported through the MPLAB which simplifies using the PICSTART Plus to a few mouse clicks. You can write your code or use a sample file, assemble it, and program it into a PIC part without ever leaving MPLAB.

The PICSTART Plus supports all the eight-pin to 40-pin PICs with a 40-pin zero insertion force (ZIF) socket that accepts dual in-line packages (DIP) only.

To program other parts such as surface-mount devices (SMD) requires a SMD to DIP adapter. You'll find most PIC programmers include DIP sockets.

The one drawback to the PICSTART Plus involves the Serial In-Circuit Programming (SICP) feature available on most PICs. With just five PIC pins RB7, RB6, /MCLR, Vdd (5V), and Vss (ground), the PIC can be programmed while still connected in a circuit.

Unfortunately, the PICSTART Plus does not have any expansion connector for (SICP). The drivers within

the PICSTART Plus won't even allow you to make a custom ZIF socket jumper that will work. Despite this, if you can afford it, the PICSTART Plus is a great option and you'll know you're always going to be supported by the makers of the PIC. Check it out at www.microchip.com.

Parallax PIC Programmer

Parallax, makers of the BASIC Stamp, also offer a PIC programmer. It's offered in two versions: a complete package and the hobbyist pack. The complete package costs \$199.00 and includes programmer, printed manual, PC cable, software, and power adapter. The hobbyist pack costs \$109.00 and includes programmer, software, and manual on disk so you have to build your own cable, find a power source, and read or print the manual from disk.

The programmer is pretty easy to use so having the manual on disk is not a big hassle. Parallax also includes some sample files so you can use the programmer, but you have to supply the PIC part or buy one from Parallax since that's not included. The programmer cable connects from the PC parallel port to the programmer through a modular phone jack plug. This makes it more difficult to find your own cable if you get the hobbyist package.

You can use a 25-pin header to

◆ New HP IICx COLOR Scanners

\$100.00



◆ USED HP DUPLEX LASER PRINTERS \$375.00



Hewlett Packard IICx - MIO Port to NetWork - 300 DPI - Can Print Double or Single Sided - Dual Letter Trays - Prints Letter or Legal Size - 3 Meg of Ram (expandable) Uses 95A Cartridges Lease Returns, All were well Maintained Under Service Contract, No Hassle 30 Day Warranty

◆ 4 meg AGP Video Cards - Diamond Stealth 3D 4000

\$50.00



◆ Slick Looking Computer Cases

AT Towers, (not ATX)

Full (260w/ps) (11 bays) \$35.00

Mid Size (230w/ps) (7 bays) \$22.00

Mini-tower (230w/ps) (6 bays) \$17.00



Microwave Goodies and Gadgets

◆ Brand New Wavetek 907AF Frequency Generators

Range is 7-12.4 Ghz **\$1000.00**

We have SMA Attenuators - Stepper Motors

The List Grows Daily!! Check the Web Site for More Low Prices

ELECTRO MAVIN

800-421-2442 or FAX 310-632-3557

E-MAIL john@mavin.com

WEB ADDRESS <http://www.mavin.com/mavin.html>

Metric
Equipment Sales, Inc.

800-432-3424

Fax: 510-264-0886

www.metricsales.com

RENT • BUY • SELL
Yes, we will buy your surplus equipment!

Scopes, Meters, Analyzers, Power Supplies, Signal Generators, Counters, Recorders and more

Hewlett-Packard, Tektronix, Fluke, Dranetz, TTC, Anritsu, Wavetek, Keithley, and more

Test & Measurement Instruments

Over 7000 Models • 6-Month Warranty

Save 30-90% • 5-Day Free Trial

modular jack converter (RadioShack part no. 276-1405a) on the PC parallel port and a normal phone cable to connect the programmer. With the hobbyist package, you also have to supply 12-18 volts from a power supply or power adapter.

I just used my Datarase EPROM eraser's power adapter. The Parallax programmer has separate 18-pin and 28-pin DIP sockets to cover the most common packages.

To program larger or smaller pin count packages requires additional adapters. Parallax has the adapters for an additional cost. Parallax's programmer has an expansion connector that is used for SSCP and adapters. I like that feature.

Parallax's programmer relies on both hardware and software (called firmware) upgrades to support new parts from Microchip. Update packages currently cost \$49.95. The programmer software runs on DOS or in a DOS window.

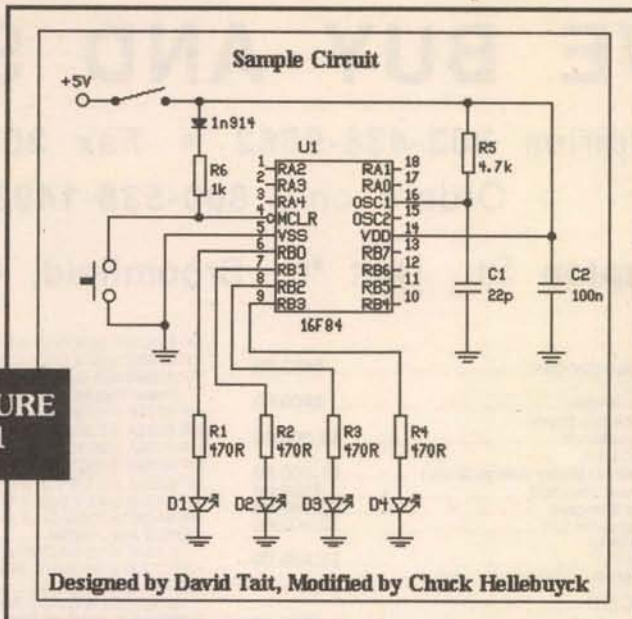
With the added costs associated with this programmer, you may wonder why I mention it. If you're just writing PIC code, then the PIC-START Plus is a more complete programming package. However, if you're writing BASIC Stamp 1 (BS1) code, the Parallax programmer has a hidden feature. It will take your BS1 code and program a 16C58A PIC with a simple ALT-I key press. For a real novice, this can be a great feature.

Develop your code using a BS1. When you're done, disconnect the BS1 cable and replace it with the Parallax programmer. Install a PIC 16C58A into the programmer and then press ALT-I instead of the ALT-R BS1 editor command. It will program the 16C58A with the BS1 code. Install the 16C58A into a circuit with resonator, /MCLR pullup resistor, Vdd (five volts), Vss (gnd), and your BS1 program is now running in a PIC. You can check out the Parallax programmer at www.parallaxinc.com.

microEngineering Labs EPIC Plus Pocket PIC Programmer

microEngineering Labs, Inc., offers a lower-cost PIC programmer. It's a very small package that will actually fit in your pocket (hence the name Pocket PIC Programmer). The programmer will run off two nine-volt batteries which makes it very portable. It costs \$59.95 for the fully assembled programmer or you can buy just the circuit board, parts list, and software for \$34.95. An optional AC adapter is available for \$9.95. The original software included is a DOS version, but a new WIN95/NT may now be available.

The programmer is controlled through the PC parallel port. An optional cable costs \$9.95, but any



Designed by David Tait, Modified by Chuck Hellebuyck

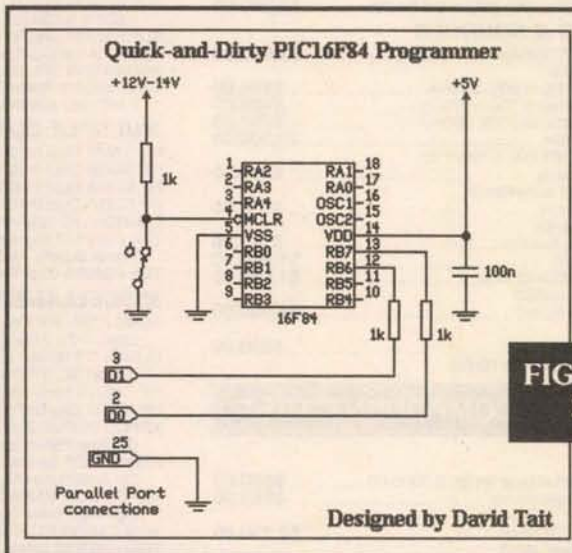


FIGURE 2

standard parallel cable should work. The programmer uses the Serial In-Circuit Programming (SICP) feature that most PICs offer. The 16C5X parts are the only PICs that don't support the SICP feature so the EPIC programmer does not support these parts.

The programmer has an 18-pin DIP socket built in which programs eight- and 18-pin PICs.

To program larger pin count PICs, or SMD PICs will require additional adapters.

The EPIC programmer has an expansion connector similar to the Parallax programmer. microEngineering Labs offers several varieties of adapters including a SICP cable/socket adapter for 16F84 flash PICs. microEngineering Labs is the same company that offers the PicBasic compilers for programming PICs in a higher level BASIC language.

The PicBasic compilers work off an instruction list very similar to the BASIC Stamp commands. This allows you to write code in PicBasic and never have to learn Microchip assembly.

I hope to cover programming with PicBasic in another *Nuts & Volts* article as I'm quickly running out of room here. microEngineering Labs does update their programmer software to keep up with the latest PIC parts. It is available for a small update fee. The

EPIC programmer is a handy little programmer. You can check out the EPIC programmer at www.melabs.com.

Ultra Cheap PIC Programmer

That title probably got your attention. As mentioned earlier, most of the PICs offer the SICP feature and you can use that to your advantage. With the right software and simple hardware, it's possible to program a PIC via three pins of your PC parallel port and a 12V/5V power supply. Thanks again to the popularity of Microchip PICs, you can find free software and hardware schematics to do this on the Internet.

One good location is David Tait's page at www.man.ac.uk/~mbhstdj/piclinks.html. His site has links to several simple PIC programmers. I built David's "Quick and Dirty" programmer for the 16F84 PIC. There are so many PIC links on David's site that it may be difficult to find the programmer I refer to. The file that contains everything you

want — including the control software — is "pic84v05.zip." To make things easier, I've added a link on my website (www.elproducts.com) so you can download the correct file.

The programmer circuit contains only a few parts and connects to the PC parallel port. The software runs in DOS or a DOS window. I built the programmer in about 20 minutes on a proto-board. David includes a sample program to test the programmer with called "walk.hex." It illuminates LEDs in a back and forth motion.

Build the sample circuit (Figure 1) with the 16F84 and LEDs in place. I added a diode to David's schematic to protect the five-volt supply and a /MCLR reset switch. Connect the Quick and Dirty programmer circuit (Figure 2) to the sample circuit per the schematic.

With five volts on Vdd and 12 volts at the /MCLR pin, enter the command "MYPP WALK.HEX" at the DOS prompt. When the program displays "Insert PIC," reset the /MCLR pin to ground and release. That puts the PIC in program mode. Press the PC enter key and the PIC will get programmed. Disconnect 12 volts and reset /MCLR again.

If you're successful, the LEDs will start scrolling back and forth. I was really impressed with how easy it was to build this programmer. It cost me nothing because I had the parts, but it shouldn't cost more than \$10.00. It really worked great although it could only program the PIC, not read or ver-

Look Ma, No BASIC Stamp*

PicBasic Compiler - \$99.95

Put BASIC Stamp I programs right into a PIC microcontroller - no BS1 module necessary! The programs run faster and can be longer. You also get more variables and extra instructions. For mid-range PIC12C67x, 16C55x, 6xx, 7xx, 8x, 9xx.

PicBasic Pro Compiler - \$249.95

PicBasic Pro is BASIC Stamp II compatible, and like the standard compiler above, eliminates the need for a BS2 module. Pro adds built-in LCD support, interrupts in BASIC, arrays, program size to 8K, real If..Then..Else and I/O to any PIC pin. For mid-range PIC12C67x, 16C55x, 6xx, 7xx, 8x, 9xx.

*BASIC Stamp is a trademark of Parallax Inc.

EPIC Plus PIC Programmer - \$59.95

Programs PIC12C50x, 67x, 16C55x, 6xx, 7xx, 8x, 9xx. Optional ZIF adapters for DIP, SOIC, MQFP, PLCC. Runs off two 9-volt batts or optional AC adapter. Includes programming software and assembler.

PICProto
Prototyping Boards

Get it wired quicker! High-quality blank prototyping boards for PICmicros. Holds 5V reg. caps, osc, DB9-25, large proto area. \$8.95 - \$17.95

microEngineering Labs, Inc.

Box 7532 Colorado Springs CO 80933
(719) 520-5323 (719) 520-1867 fax

<http://www.melabs.com>
email: info@melabs.com

Write in 56 on Reader Service Card.

ify the programmed PIC. You can't get much cheaper than this.

Summary

For any PIC programmer, your programs have to be in HEX format (designated INHX8M by Microchip). Almost any PIC assembler will create that file format. The MPASM assembler from Microchip is my choice. It comes with MPLAB.

Programming PICs is fun and easy. Hopefully, I've made your path to programming PICs a little easier as well. The toughest part about PICs is writing the programs. If you're not familiar with Microchip assembly code, it will take a little while to figure it out.

I find it very powerful and worth the effort to learn. There are only 35 different commands to remember for the most common parts. If you're a real beginner or moving up from the BASIC Stamps, then PicBasic programming language may be the route for you. I'll talk more about this in another article. Until then, pick your PIC programming path and have fun. NV

Comments or questions can be sent to the author at chuck@elproducts.com.

Be sure to check out Chuck Hellebuyck's Electronic Products website at: www.elproducts.com.

WESTERN TEST SYSTEMS

WE BUY AND SELL

Inquiries 303-438-9662 • Fax 303-438-9685

Orders only 800-538-1493

530 Compton St., Unit #C, Broomfield, Colorado 80020

OSCILLOSCOPES & ACCESSORIES

TO 100 MHz

TEK 7A22 1 MHz High CMRR Differential Amplifier	\$250.00
TEK 7B53A 100 MHz Dual Time Base	\$175.00
TEK SC502 15 MHz Dual Trace Oscilloscope, TM500 series	\$375.00

ABOVE 100 MHz

TEK 2465 300 MHz 4-channel Oscilloscope	\$2,500.00
TEK 7104 1 GHz Oscilloscope, with 7A29, 7A29-04, 7B10, 7B15	\$4,500.00
TEK 7844 400 MHz Dual Beam Oscilloscope frame	\$600.00
TEK 7844 400 MHz Dual Beam Oscilloscope with 7A24, 7A26, 7B80, 7B85	\$1,000.00
TEK 7904A 500 MHz System, with 7A24, 7A26, 7B80, 7B85	\$1,250.00
TEK 7A13 105 MHz Differential Comparator	\$225.00
TEK 7A19 600 MHz Single Trace Amplifier	\$150.00
TEK 7A24 400 MHz Dual Trace Amplifier	\$300.00
TEK 7A26 200 MHz Dual Trace Amplifier	\$175.00
TEK 7A42 4-Channel Logic Triggered Vertical Amplifier	\$500.00
TEK 7B15 1 GHz Delaying Time Base	\$450.00
TEK 7B80 400 MHz Delayed Time Base	\$175.00
TEK 7B85 400 MHz Delta Delaying Time Base	\$175.00
TEK 7B92A 500 MHz Dual Time Base	\$275.00

STORAGE

TEK 7633 100 MHz Storage Oscilloscope frame	\$600.00
TEK 7633 100 MHz Storage Oscilloscope with (2) 7A26, (1) 7B92A	\$900.00

PROBES

HP 1122A Probe Power Supply	\$150.00
TEK 1101 Accessory Power Supply, for FET probes	\$250.00
TEK P6046 100 MHz Differential Probe	\$750.00
TEK P6201 900 MHz 1X/10X/100X FET Probe	\$450.00
TEK P6202A 500 MHz 10X FET Probe	\$300.00
TEK P6203 1 GHz 10X Active Probe, for 11000 series	\$375.00
TEK P6701-opt.02 O/E Converter, 450-1050 nm/0-1 mW; DC-700 MHz, ST conn.	\$375.00

CALIBRATION

TEK SG503 Level Generator, 250 kHz-250 MHz, TM500 series	\$600.00
--	----------

WAVEFORM GENERATORS

FUNCTION

HP 3310A 5 MHz Function Generator	\$250.00
HP 3310B 5 MHz Function Generator, monocyde & var. phase trigger	\$325.00
HP 3312A 13 MHz Function Generator	\$650.00
HP 3325A 21 MHz Synthesized Function Generator, HP1B	\$1,650.00
HP 3325A-002 21 MHz Function Generator, high voltage output option	\$1,750.00
HP 8165A-002,003 Prog. Signal Source, 1 MHz-50 MHz, log sweep, rear out	\$2,000.00
HP 8904A-002,004 Multifunction Synthesizer, DC-600 kHz, HP1B	\$2,500.00
TEK AWG5102 Arb.Waveform Gen., 20 MS/s, 12 bits, 50ppm synthesis <1MHz	\$900.00
TEK AWG5105-opt.02 Arbitrary Waveform Generator, dual channel option	\$1,250.00
TEK DD501 Digital Delay & Burst Gen., for function & pulse gen's	\$275.00
TEK FG501 1 MHz Function Generator, TM500 series	\$225.00
TEK FG502 11 MHz Function Generator	\$300.00
TEK FG503 3 MHz Function Generator, TM500 series	\$250.00
TEK RG501 Ramp Generator, TM500 series	\$225.00
WAVETEK 185 5 MHz Lin/Log Sweep/Function Generator	\$300.00
WAVETEK 288 20 MHz Synthesized Function Generator, GPIB	\$750.00

PULSE

BERKELEY NUCLEONICS 7085B Digital Delay Generator, 0-100 mS, 1 nS res., 5 Hz-5 MHz	\$750.00
HP 8007B 100 MHz Pulse Generator	\$650.00
HP 8012B 50 MHz Pulse Generator, variable transition time	\$600.00
HP 8015A-002 50 MHz Dual Output Pulse Generator, gated burst option	\$750.00
HP 8080A/81A/83A/84A 300 MHz Word Generator	\$800.00
HP 8080A/91A/92A/93A 1 GHz Single Channel Pulse Generator	\$950.00
HP 8111A 20 MHz Pulse / Function Generator	\$1,500.00
HP 8115A 50 MHz Dual Channel Pulse Generator, HP1B	\$3,500.00
TEK PG502 250 MHz Pulse Generator, Tr<1nS, TM500 series	\$600.00
TEK PG505 100 kHz Pulse Generator, 80 V peak, TM500 series	\$275.00
TEK PG508 50 MHz Pulse Generator, TM500 series	\$500.00
WAVETEK 802 50 MHz Pulse Generator	\$300.00

VOLTAGE & CURRENT

VOLTMETERS

FLUKE 845AR High Impedance Voltmeter / Null Detector	\$500.00
HP 3456A 6-1/2 Digit Voltmeter	\$750.00
HP 3478A 5-1/2 digit Multimeter, HP1B	\$700.00
KEITHLEY 155 Null Detector/ Microvoltmeter, 1 uV-1000 V f.s.	\$200.00
KEITHLEY 181 6-1/2 digit Nanovoltmeter, 10 nV sensitivity, GPIB	\$900.00
SOLARTRON 7081 8-1/2 digit Voltmeter	\$3,900.00
TEK DM501A 4-1/2 digit Multimeter, TM500 series plug-in	\$225.00

CALIBRATION

FLUKE 510A AC Reference Standard, 10 VRMS, 0-10 mA	\$450.00
FLUKE 515A Portable Calibrator, DC/AC/Ohms, line & battery power	\$900.00
FLUKE 5220A Transconductance Amplifier, DC-5 kHz, 0-20 A	\$3,000.00
FLUKE 720A 7-decade Kelvin-Variety Voltage Divider	\$1,250.00
FLUKE 731B DC Reference Standard	\$400.00
FLUKE 732A DC Voltage Standard	\$2,000.00
HOLT 11 AC Thermal Converter Set, 0.5-1200 V, 20 Hz-30 MHz	\$2,000.00
VALHALLA 2703 AC Volt.Std., 0-120V/10 Hz-100 kHz; 120-1200V/10 Hz-1 kHz	\$2,250.00

VOLTAGE SOURCES

HP 6115A Precision Dual Range Power Supply, 50V 0.8A / 100V 0.4A	\$850.00
KEITHLEY 228 Programmable Voltage/Current Source	\$2,500.00

CURRENT METERS & SOURCES

HP 4140B Picoammeter / DC Voltage Source, without test fixture	\$2,000.00
HP 6177C DC Current Source, to 50V, 500mA	\$500.00
HP 6181C DC Current Source, to 100 V, 250 mA	\$500.00
HP 6186C DC Current Source, to 300V, 100mA	\$750.00
KEITHLEY 220 Programmable Current Source, 0.5 pA-101 mA, 1-105 V lim	\$2,000.00
KEITHLEY 225 Current Source, 0.1 uA-100 mA, 10-100 V compliance	\$500.00
KEITHLEY 227 Current Source, 1 uA-1 A, 0-50 V compliance	\$800.00
KEITHLEY 261 Picoampere Source	\$375.00
KEITHLEY 642 Electrometer	\$1,500.00
TEK A6303 Current Probe, DC-15 MHz, 100 A max., for use with AM503	\$1,000.00
TEK AM503/A6302/TM501 AC/DC Current Probe System	\$1,000.00
TEK CT-5-opt.05 High Current Transformer for P6021/A6302, to 1000A	\$300.00

IMPEDANCE & COMPONENT TEST

L.C.R.

BOONTON 62AD 1 MHz Inductance Meter, 2-2000 uH	\$550.00
BOONTON 72BD 1 MHz Capacitance Meter, 3-1/2 digit display	\$650.00
HP 4262A-101 3-1/2 digit LCR Meter, 120 Hz/ 1 kHz/ 10 kHz test, HP1B	\$2,250.00
HP 4275A-001 5-1/2 digit LCR Meter, 10 kHz-10 MHz, 0-35 V int. bias	\$5,000.00

STANDARDS

E.S.I. DB62-11K 6-Decade Resistor, 0-11,111.10 Ohms, 0.01 Ohm res.	\$300.00
E.S.I. SR1010 Resistance Transfer Standards, 1 Ohm-100 K/step	\$550.00
E.S.I. SR1050-1M Resistance Transfer Standard, 1 Megohm/step	\$2,000.00
GR 1404-A 1000 pF Reference Standard Capacitor	\$700.00
GR 1406 Standard Air Capacitors, GR900 connector, 0.1% acc.	\$375.00
GR 1412-BC Decade Capacitor, 50 pF - 1.11115 uF	\$350.00
GR 1432-U 4-Decade Resistor, 0-111.10 Ohms, 0.01 Ohm resolution	\$125.00
GR 1433-J 4-Decade Resistor, 0-11,110 Ohms, 0.1 Ohm resolution	\$250.00
GR 1433-K 4-Decade Resistor, 0-1,110 Ohms, 0.1 Ohm resolution	\$250.00
GR 1433-L 4-Decade Resistor, 0-111,100 Ohms, 10 Ohms resolution	\$250.00
GR 1433-N 5-Decade Resistor, 0-11,111 Ohms, 0.1 Ohm resolution	\$300.00
GR 1433-U 4-Decade Resistor, 0-111.0 Ohms, 0.01 Ohm resolution	\$250.00
GR 1433-X 6-Decade Resistor, to 111,111.0 Ohms, 0.1 Ohm res.	\$350.00
GR 1482-series Standard Inductors	\$275.00
VALHALLA 2724A Programmable Resistance Standard, 0-11 Gigaohms, GPIB	\$1,675.00

HI & LO RESISTANCE

HP 4328A Milliohmeter	\$1,200.00
-----------------------	------------

CURVE TRACERS

TEK 577D1/177 Storage Curve Tracer, with standard test fixture	\$2,250.00
TEK 577D2/177 Curve Tracer, with standard test fixture	\$1,850.00

T.D.R.

TEK 1502-opt.04 Time Domain Reflectometer, 0-2,000 feet, chart recorder	\$1,400.00
TEK 1503-opt.04 Time Domain Reflectometer, 0-50,000 feet, chart recorder	\$1,400.00

POWER SUPPLIES

SINGLE OUTPUT

HP 6002A-001 0-60 V/ 0-10 A/ 200 Watts max. Autorange Power Supply	\$750.00
HP 6011A Autorange 0-20 V 0-120 A Power Supply, 1000 W max.	\$1,400.00
HP 6200B Dual Range Supply, 0-20 V 0-1.5 A/ 0-40 V 0-750 mA CVCC	\$200.00
HP 6201B 0-20 V 0-1.5 A CV/CC Power Supply	\$175.00
HP 6207B 0-160 V 0-200 mA CV/CC Power Supply	\$300.00
HP 6256B 0-10 V 0-20 A CV/CC Power Supply	\$300.00
HP 6260B-027 0-10 V 0-100 A CV/CC Power Supply; 208 VAC line	\$675.00
HP 6261B-027 0-20 V 0-50 A CV/CC Power Supply; 208 VAC line	\$675.00

HP 6263B 0-20 V 0-10 A CV/CC Power Supply	\$400.00
HP 6266B 0-40 V 0-5 A CV/CC Power Supply	\$400.00
HP 6269B-028 0-40 V 0-50 A CV/CC Power Supply; 230 VAC line	\$950.00
HP 6271B 0-60 V 0-3 A CV/CC Power Supply	\$400.00
HP 6281A 0-7.5 V 0-5 A CV/CC Power Supply	\$175.00
HP 6284A 0-20 V 0-3 A CV/CC Power Supply	\$225.00
HP 6299A 0-100 V 0-750 mA CV/CC Power Supply	\$225.00
HP 6384A 4.0-5.5 V at 8 A CV/CL Power Supply	\$125.00
HP 6434B 0-40 V 0-25 A CV/CC Power Supply	\$800.00
HP 6443B 0-120 V 0-2.5 A CV/CC Power Supply	\$450.00
KEPCO ABC-1500M	\$125.00

0-1500 V 10 mA CV/CL Power Supply	
KEPCO ATE 36-30M 0-36 V 0-30 A CV/CC Power Supply	\$900.00
KEPCO ATE 36-8M	\$375.00
0-36 V 0-8 A CV/CC Power Supply	
SORENSEN DCR 20-25B	\$550.00
0-20 V 0-25 A CV/CC Power Supply	
SORENSEN DCR 600-0.75B	\$600.00
0-600 V 0-750 mA CV/CC Power Supply	
SORENSEN SRL 20-12 0-20 V	\$400.00
0-12 A CV/CC Power Supply	
SORENSEN SRL 60-8 0-60 V 0-8 A CV/CC Power Supply	\$600.00
TEK PS501-1 Power Supply, 0-20 V, 2 mV res., 400 mA, TM500 series	\$175.00

MULTIPLE OUTPUT

HP 6227B Dual 0-25 V 0-2 A CV/CC Power Supply	\$600.00
HP 6228B Dual 0-50 V 0-1 A CV/CC Power Supply	\$600.00
HP 6253A Dual 0-20 V 0-3 A CV/CC Power Supply	\$500.00
HP 6255A Dual 0-40 V 0-1.5 A CV/CC Power Supply	\$500.00
LAMBDA LPT-7202-FM Triple Output Power Supply	\$450.00
TEK PS5010 Programmable Triple Power Supply, TM500 series	\$750.00
TEK PS503A Dual Power Supply, TM500 series	\$200.00

MISCELLANEOUS

ACME PS2L-500 Programmable Load, 0-75 V / 0-75 A / 500 Watts max.	\$400.00
ELGAR 1751B/461 AC Power Source, 0-135 VAC, 1750 Watts, fixed freq. osc.	\$2,000.00
HP 59501B HP1B Isolated DAC/Power Supply Programmer	\$175.00
HP 6825A Bipolar Power Supply/ Amplifier, +/- 20 V 2 A	\$800.00
KEPCO BOP 20-20M Bipolar Op Amp/Power Supply, to 20 V 20 A	\$675.00
KEPCO BOP 36-5M Bipolar Op Amp/Power Supply, to 36 V 5 A	\$400.00
KEPCO BOP 50-2M Bipolar Op Amp/Power Supply, to 50 V 2 A	\$400.00
ROD-L M100DC 0-5 kVDC 0-5 mA HIPOT	\$450.00
TRANSISTOR DEVICES DAL-50-15-100 Programmable Load, 0-50 V, 0-15 A, 100 Watts max.	\$200.00

TIME & FREQUENCY

UNIVERSAL COUNTERS

HP 5315A-003 100 MHz/100 nS Univ. Counter, 1 GHz C-channel option	\$550.00
HP 5315A-001 100 MHz/100 nS Universal Counter, TCXO reference option	\$450.00
HP 5315B 100 MHz/ 100 nS Universal Counter	\$500.00
HP 5316A 100 MHz/100 nS Universal Counter, HP1B	\$600.00
HP 5316A-001,003 100 MHz/ 100 nS Univ. Counter, HP1B, TCXO, 1 GHz C-ch.	\$750.00
HP 5316B 100 MHz/ 100 nS Universal Counter, HP1B	\$1,000.00
HP 5334A 100 MHz Universal Counter, HP1B	\$750.00
HP 5334A-010,030,050 100 MHz Univ.Counter; OCXO, DVM, 1.3 GHz C-ch., rear in	\$1,000.00
HP 5334B-010,060 100 MHz Universal Counter, HP1B, OCXO	\$750.00
HP 5335A 200 MHz Universal / Statistical Counter	\$850.00
PHILIPS PM6665/431 120 MHz/ 100 nS Universal Counter, 1.3 GHz C-ch., TCXO	\$600.00
TEK DC5004 Programmable 100 MHz/100nS Counter/Timer, TM5000 series	\$250.00
TEK DC5009 Programmable 135 MHz Univ. Counter/Timer, TM5000 series	\$400.00
TEK DC5010 350 MHz / 3.125 nS Universal Counter, TM5000 series	\$1,200.00
TEK DC503A 125 MHz/100 nS Universal Counter, TM500 series	\$275.00

FREQUENCY COUNTERS

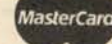
EIP 575 18 GHz Source Locking Counter, GPIB	\$2,500.00
EIP 578-opt.02,05 26.5 GHz Source Locking Counter; power meas., OCXO	\$4,000.00
FLUKE 7220A-010,131,351 1.3 GHz Counter; battery power, OCXO, and res. mult.	\$500.00
HP 5340A 18 GHz Frequency Counter	\$900.00
HP 5342A 18 GHz Frequency Counter	\$1,500.00
HP 5342A-001 18 GHz Frequency Counter, OCXO reference	\$1,600.00
HP 5342A-001,011 18 GHz Frequency Counter, OCXO reference & HP1B	\$1,750.00
HP 5342A-003 18 GHz Freq. Counter, +22 dBm, -20 dBm dynamic range	\$1,500.00
HP 5342A-01,04,05 24 GHz Frequency Counter, OCXO, DAC	\$2,250.00
HP 5343A-001 26.5 GHz Frequency Counter, OCXO reference	\$4,000.00
HP 5345A/5355A/5356B 26.5 GHz CW/Pulse Frequency Counter	\$4,000.00
HP 5384A 225 MHz Frequency Counter, HP1B	\$500.00
TEK DP501 1.3 GHz Prescaler, divide by 16, TM500 series	\$225.00

STANDARDS

HP 105B Quartz Oscillator, 0.1/ 1.0/ 5.0 MHz, battery power	\$1,500.00
HP 5087A-4,11,01x8,12x4 Dist. Amp., eight 5 MHz outputs, four 10 MHz outputs	\$1,500.00
HP 5087A-opt.033 Distribution Amplifier; 12 outputs at 10 MHz	\$1,750.00



90 DAY WARRANTY PARTS AND LABOR • 10 DAY INSPECTION TEST EQUIPMENT WANTED CALL OR FAX LIST • OPEN ACCOUNTS



AUDIO & BASEBAND

SPECTRUM ANALYSIS

HP 3586C Selective Level Meter, 50 Hz-32.5 MHz, 50 & 75 ohms	\$1,500.00
TEK 7L5/L3/R7603 Spectrum Analyzer, 20 Hz-5 MHz, 10 Hz min. res., w/frame	\$1,500.00

DISTORTION ANALYZERS

HP 339A Distortion Analyzer, built-in low distortion osc.	\$1,250.00
HP 8903A-001 Audio Analyzer, 20 Hz-100 kHz; rear panel input	\$2,000.00
HP 8903B-001,013,051 Audio Analyzer, 20 Hz-100 kHz; C-message, CCITT	\$2,500.00
TEK DA4084 Programmable Distortion Analyzer	\$1,000.00

RMS VOLTMETERS

FLUKE 8920A True RMS Voltmeter, 180 uV-700 V, 10 Hz-20 MHz	\$450.00
FLUKE 8922A True RMS Voltmeter, 180 uV-700 V, 2 Hz-11 MHz	\$450.00
HP 209A Sine/Square Wave Generator, 4 Hz-2 MHz, 5 VRMS max.	\$225.00

OSCILLATORS

HP 3336C Synthesizer/Level Generator, 10 Hz-21 MHz	\$1,400.00
TEK SG5010 Programmable Oscillator, 10 Hz-163.8 kHz	\$2,750.00
TEK SG502 Sine/Square Osc., 5 Hz-500 kHz, 70 dB step atten., TM500	\$200.00

MISCELLANEOUS

HP 3575A-001 Phase-Gain Meter, 1 Hz-13 MHz, dual display option	\$850.00
HP 461A Amplifier, 20/40 dB, 1 kHz-150 MHz, 0.5 V/50 Ohms	\$125.00
KROHN-HITE 3103 High/Low Pass Filter, 10 Hz-3 MHz, 24 dB/octave	\$400.00
KROHN-HITE 3202 Dual HP/LP/BR Filter, 20 Hz-2 MHz, 24 dB/octave	\$450.00
KROHN-HITE 3342R Dual HP/LP Filter, 0.001 Hz-99.9 kHz, 48 dB/octave	\$900.00
KROHN-HITE 3750 LP/HP/BR/BR Filter, 0.02 Hz-20 kHz, 6/12/18/24 dB/oct.	\$600.00
KROHN-HITE DCA-10R 10 Watt Amplifier, 20 dB gain, DC-1 MHz, 600-1000 Ohms	\$450.00
ROCKLAND 852 Dual Highpass/Lowpass Filter, 0.1 Hz-111 kHz	\$1,000.00
TEK AF501 Tunable Bandpass Filter / Amplifier, 3 Hz-35 kHz	\$300.00
TEK AM502 Differential Amplifier, 0.1 Hz-1 MHz, TM500 series	\$475.00

RF & MICROWAVE

SPECTRUM ANALYZERS

HP 11517A/19A/20A Mixer Set, 18.0-40.0 GHz, for HP 8555A/8569A	\$600.00
HP 11970A WR28 Harmonic Mixer, 26.5-40 GHz	\$1,100.00
HP 11970K WR42 Harmonic Mixer, 18.0-26.5 GHz	\$1,100.00
HP 11970Q WR22 Harmonic Mixer, 33-50 GHz	\$1,400.00
HP 11970U WR19 Harmonic Mixer, 40-60 GHz	\$1,400.00
HP 8444A-059 Tracking Generator, 0.5-1500 MHz, for 8554, 8568, etc.	\$1,250.00
HP 8445B Preselector, 1.8-18.0 GHz, for HP 8555A	\$650.00
HP 853A-001 Spectrum Analyzer, Display, bench/rack mount config.	\$1,250.00
HP 8565A-100 Spectrum Analyzer, 10 MHz-22 GHz, 100 Hz min. res.	\$4,500.00
HP 8566B Spectrum An., 100 Hz-22 GHz, HP calibration certificate	\$37,500.00
HP 8569B Spectrum Analyzer, 10 MHz-22 GHz, 100 Hz min. res. bw.	\$7,500.00
TEK 7L14-039/7603 Spectrum Analyzer, 1 kHz-2.5 GHz, 30 Hz min. res. bw.	\$2,500.00
TEK TR503 Tracking Generator, 0.1-1800 MHz, for 492/4/5/6	\$850.00
TEK WM782V WR15 Harmonic Mixer, 50-75 GHz	\$1,500.00

NETWORK ANALYZERS

HP 85021C Directional Bridge, 0.01-18 GHz, 33 dB dir. for 8755/6/7	\$1,000.00
HP 8753A Network Analyzer, 300 kHz-3 GHz	\$7,500.00
HP 8756A Scalar Network Analyzer	\$2,500.00

SIGNAL GENERATORS

FLUKE 6060A Synthesized Signal Gen., 0.1-1050 MHz, 10 Hz res., GPIB	\$2,750.00
FLUKE 6060A/AN Synthesized Signal Gen., 10 kHz-520 MHz, 10 Hz res., GPIB	\$1,750.00
FLUKE 6062A Synthesized Signal Gen., 0.1-2100 MHz, 10 Hz res., GPIB	\$5,000.00
GIGATRONICS 1018 Synthesized Signal Gen., 50 MHz-18 GHz, 1 MHz res.	\$4,500.00
GIGATRONICS 600/10-18 Synthesized Source, 10-18 GHz, 1 MHz res., GPIB	\$2,500.00
GIGATRONICS 600/6-12 Synthesized Source, 6-12 GHz, 1 kHz res., GPIB	\$2,500.00
GIGATRONICS 875/50 Levelled Multiplier, x4, 50.0-75.0 GHz output, -3 dBm	\$2,500.00
GIGATRONICS 875/86 Levelled Multiplier, 26.5-40.0 & 50.0-75.0 GHz outputs	\$3,750.00
GIGATRONICS 900/2-8 Synthesized Signal/Sweep Gen., 2-8 GHz, 1 kHz res., GPIB	\$3,000.00
HP 11720A Pulse Modulator, 2-18 GHz, 80 dB on/off ratio	\$450.00
HP 85100V Frequency Mult., 10-15 GHz in / 50-75 GHz out >0 dBm	\$3,750.00
HP 8640B-001,002 Signal Gen., 0.5-1024 MHz, AM, FM, var. audio osc.	\$1,750.00
HP 8656A Synthesized Signal Gen., 0.1-990 MHz, 100 Hz res., HP1B	\$2,500.00
HP 8657A-002 Signal Generator, 0.1-1040 MHz, 10 Hz res., HP1B	\$3,250.00
HP 8660C/86602B-002 Synth. Sig. Gen., 1-1300 MHz, FM / Phase mod. w/86635A	\$3,250.00
HP 8660C/86603A-002 Synthesizer, 1-2600 MHz, FM / Phase Mod., w/86635A	\$4,500.00
HP 8672A Synthesized Signal Generator, 2-18 GHz	\$6,000.00
HP 8684B Signal Generator, 5.4-12.5 GHz, AM, WBFB, Pulse	\$3,500.00

SWEEP GENERATORS

HP 8350A/83545A-002 Sweep Oscillator, 5.9-12.4 GHz, 70 dB step attenuator	\$4,000.00
HP 8350B/83592B-002 Sweep Generator, 10 MHz-20 GHz, 70 dB step attenuator	\$14,500.00
HP 83545A RF Plug-in, 5.9-12.4 GHz, +17 dBm levelled	\$1,750.00
HP 8601A Generator/Sweeper, 0.1-110 MHz, +20 dBm levelled	\$400.00
HP 8620C Sweep Oscillator Frame	\$550.00
HP 86222B-002 RF Plug-in, 10-2400 MHz, +13 dBm levelled, 70 dB atten.	\$1,500.00
HP 86230B RF Plug-in, 1.8-4.2 GHz, +10 dBm unlevelled	\$500.00
HP 86235A-001,002 RF Plug-in, 1.7-4.3 GHz, +14 dBm levelled, 70 dB atten.	\$600.00
HP 86240C RF Plug-in, 3.6-8.6 GHz, +16 dBm levelled	\$700.00
HP 86241A-001 RF Plug-in, 3.2-6.5 GHz, +8 dBm levelled	\$300.00
HP 86242D-004,008 RF Plug-in, 5.9-9.0 GHz, +10 dBm levelled	\$300.00
HP 86250D RF Plug-in, 8.0-12.4 GHz, +10 dBm levelled	\$500.00
HP 86260A RF Plug-in, 12.0-18.0 GHz, +10 dBm unlevelled	\$500.00
HP 86260A-H04 RF Plug-in, 10.0-15.0 GHz, +10 dBm unlevelled	\$500.00
HP 86290A RF Plug-in, 2.0-18.0 GHz, +7 dBm levelled	\$1,750.00
HP 86290B RF Plug-in, 2.0-18.6 GHz, +10 dBm levelled	\$2,000.00
WAVEVEK 962 Sweep Generator, 1.0-4.0 GHz, markers, +12 dBm unlvld.	\$1,500.00
WILTRON 6619A Sweep Generator, 2-8 GHz, +10 dBm levelled	\$1,500.00

POWER METERS

ANRITSU MA72B Power Sensor, -20 to +20 dBm, 0.01-18 GHz	\$200.00
ANRITSU MP-81B/ML-83A Power Meter, 75-110 GHz (WR10), -20 to +20 dBm	\$2,500.00
BOONTON 4200-01A,03/8-4A x2 Dual Channel Microwattmeter, w/(2) 1 MHz-7 GHz sensors	\$1,500.00
BOONTON 42B/41-4B Analog Power Meter, with 1 MHz-12 GHz sensor	\$375.00
BOONTON 42B/41-4E Analog Power Meter, with 1 MHz-18 GHz sensor	\$500.00
GENERAL MICROWAVE 476/4240A Power Meter & Sensor, 0.01-18 GHz, -35 to +10 dBm	\$300.00
HP 435B/8482B Power Meter, 0 to +43 dBm, 100 kHz-4.2 GHz	\$1,800.00
HP 435B/8482H Power Meter, 0.1-4200 MHz, -10 to +34 dBm	\$950.00
HP 436A Power Meter	\$900.00
HP 8477A Power Meter Calibrator, for HP 432 series	\$500.00
HP K486A WR42 Thermistor Mount, 18.0-26.5 GHz, for 432 series	\$350.00
HP Q8486A Power Sensor, 33.0-50.0 GHz, WR22, for 435/6/7/8	\$1,500.00
HP R486A WR28 Thermistor Mount, 26.5-40 GHz, for 432 series	\$350.00

RF MILLIVOLTMETERS

BOONTON 92B-opt.05 RF Millivoltmeter, 10 kHz-1.2 GHz, 75 Ohms scale	\$500.00
RACAL 9303 TRMS Level Meter, 10 kHz-2 GHz, -77 to +23 dBm, GPIB	\$875.00

AMPLIFIERS, MISCELLANEOUS

AMPLIFIER RESEARCH 1W1000 Amplifier, 30 dB gain, 1-1000 MHz, 1 Watt output	\$650.00
BOONTON 82AD-opt.01A Modulation Meter, AM, FM, 10-1200 MHz, GPIB	\$900.00
HP 11715A AM/FM Test Source	\$1,600.00
HP 415E SWR Meter	\$300.00
HP 465A Amplifier, 20/40 dB, 5 Hz-1 MHz, 1/2 Watt/50 Ohms	\$125.00
HP 8447A Amplifier, 20 dB, 0.1-400 MHz, 5 dB NF, +6 dBm output	\$375.00
HP 8447E Amplifier, 22 dB, 0.1-1300 MHz, +13 dBm output	\$750.00
HP 8447F Preamplifier / Power Amplifier, 0.1-1300 MHz	\$1,200.00
HP 8901A Modulation Analyzer, 150 kHz-1300 MHz	\$3,000.00
HP 8901B-1,2,3 Modulation An., 0.15-1300 MHz, rear input, OCKO, ext.LO	\$4,000.00
HP 8970A Noise Figure Meter	\$5,000.00
HUGHES 1177H02F000 TWT Amplifier, 4.0-8.0 GHz, 10 Watts output	\$1,500.00
MICROWAVE SEMI. CORP. MC5112 Noise Source, 25.5 dB ENR, 1.0-12.4 GHz, N(m), +28 VDC	\$275.00
ROHDE & SCHWARTZ ESH2 Test Receiver, 9 kHz-30 MHz	\$5,000.00

COAXIAL & WAVEGUIDE

AMERICAN NUCLEONICS AM-432 Cavity Backed Spiral Antenna, LHC, 2-18 GHz, TNC(f) "NEW"	\$95.00
FXR/MICROLAB S3-02N Triple Stub Tuner, 200-1000 MHz, 100 Watts max., N(m/f)	\$125.00
GR 874-LTL Constant Impedance Trombone Line, 0-44 cm, DC-2 GHz	\$400.00
GR 900-Q GR900 14mm Interseries Adapters	\$125.00
HP 11590A-001 Bias Network, 1.0-18.0 GHz, APC7	\$450.00
HP 11612A Bias Network, 45 MHz-26.5 GHz, APC3.5	\$550.00
HP 11691D Directional Coupler, 22 dB, 2-18 GHz	\$450.00
HP 774D Dual Directional Coupler, 20 dB, 215-450 MHz	\$275.00
HP 777D Dual Directional Coupler, 20 dB, 1.9-4.1 GHz	\$275.00
HP 778D-011 Dual Dir. Coupler, 20 dB, 100-2000 MHz, APC7 test port	\$450.00
HP 8431A 2-4 GHz Band Pass Filter, N(m/f)	\$175.00
HP 8470B Crystal Detector, 10 MHz-18 GHz, neg. pol., APC7	\$250.00
HP 8472A Crystal Detector, 10 MHz-18 GHz, neg. pol., SMA	\$150.00
HP 8494B-002 Step Attenuator, 0-11 dB, DC-18 GHz, SMA(f/f)	\$450.00
HP 8494G-002 Programmable Step Attenuator, 0-11 dB, DC-4 GHz, SMA	\$350.00
HP 8495G-002 Programmable Step Attenuator, 0-70 dB, DC-4 GHz, SMA	\$300.00
HP 8495H-002 Programmable Step Attenuator, 0-70 dB, DC-18 GHz, SMA	\$400.00
HP 8496B-002 Step Attenuator, 0-110 dB, DC-18 GHz, SMA(f/f)	\$450.00
HP 8497K-004 Programmable Step Attenuator, 0-90 dB, DC-26.5 GHz	\$750.00
HP K422A WR42 Flat Broadband Detector, 18.0-26.5 GHz	\$350.00

HP K532A WR42 Frequency Meter, 18.0-26.5 GHz	\$450.00
HP K870A WR42 Slide Screw Tuner, 18.0-26.5 GHz	\$275.00
HP K914B WR42 Moving Load, 18.0-26.5 GHz	\$350.00
HP Q752D WR22 Directional Coupler, 20 dB, 33-50 GHz	\$650.00
HP R375A WR28 Variable Attenuator, 0-20 dB, 26.5-40 GHz	\$375.00
HP R532A WR28 Frequency Meter, 26.5-40 GHz	\$500.00
HP R752A WR28 Directional Coupler, 3 dB, 26.5-40 GHz	\$450.00
HP R914B WR28 Moving Load, 26.5-40 GHz	\$300.00
HP V365A WR15 Isolator, 25 dB, 50-75 GHz	\$900.00
HP V752D WR15 Directional Coupler, 20 dB, 50-75 GHz	\$650.00
HP X870A WR90 Slide Screw Tuner	\$150.00
HUGHES 45111H-2000 WR28 Isolator, 25 dB, 26.5-40 GHz	\$450.00
HUGHES 45712H-1000 WR22 Frequency Meter, 33-50 GHz	\$900.00
HUGHES 45732H-1200 WR22 Level Set Attenuator, 0-25 dB, 33-50 GHz	\$250.00
HUGHES 45772H-1100 WR22 Thermistor Mount, -20 to +10 dBm, 33-50 GHz	\$400.00
HUGHES 45775H-1100 WR12 Thermistor Mount, -20 to +10 dBm, 60-90 GHz	\$800.00
HUGHES 47316H-1111 WR10 Tuneable Detector, 75-110 GHz, positive polarity	\$600.00
HUGHES 47323H-1211 WR19 Flat Broadband Detector, negative, 40-60 GHz	\$650.00
HUGHES 47974H-1000 WR15 SPST PIN Switch, 250 MHz speed, 60-62 GHz response	\$375.00
KAY 442D Step Attenuator, 0-101 dB, 75 ohms, BNC	\$100.00
KRYTAR 1818 Directional Coupler, 16 dB, 2-18 GHz, SMA(f)	\$200.00
M/A-COM 3-19-300/10 WR19 Directional Coupler, 10 dB, 40-60 GHz	\$450.00
MIDWEST MICROWAVE 3537 DC Block, 0.1-12.4 GHz, SMA(m/f) "NEW"	\$40.00
MINI-CIRCUITS ZFDC-20-4 Directional Coupler, 19.5 dB, 1-1000 MHz, SMA(f)	\$25.00
MINI-CIRCUITS ZHL-42 Amplifier, 30 dB gain, 0.7-4.2 GHz, +28 dBm, 15V, SMA	\$400.00
NARDA 25171 Level Set Attenuator, 0-17 dB, 2-8 GHz, SMA(f)	\$100.00
NARDA 3000-SERIES Directional Couplers	\$150.00
NARDA 3024 Bi-Directional Coupler, 20 dB, 4-8 GHz	\$300.00
NARDA 3090-SERIES Precision High Directivity Couplers	\$225.00
NARDA 368NM Coaxial High Power Load, 500 Watts, 2.0-12.4 GHz, N(m)	\$400.00
NARDA 369BNF High Power Termination, 175 Watts, 0.7-18 GHz, N(f)	\$325.00
NARDA 3753B Coaxial Phase Shifter, 0-55 deg./GHz, 3.5-12.4 GHz	\$1,250.00
NARDA 4000-SERIES SMA Miniature Directional Couplers	\$75.00
NARDA 4245-10 Directional Coupler, 10 dB, 4-12 GHz, SMA(f)	\$100.00
NARDA 4799 Level Set Attenuator, 0-15 dB, 4-18 GHz, SMA(f)	\$135.00
NARDA 5070-SERIES Precision Reflectometer Couplers	\$300.00
NARDA 765-10 10 dB Attenuator, 50 Watts, DC-5 GHz, N(m/f)	\$135.00
NARDA 792FF Variable Attenuator, 0-20 dB, 2.0-12.4 GHz	\$375.00
NARDA 794FM Direct Reading Variable Attenuator, 0-40 dB, 4-8 GHz	\$375.00
OMNI-SPECTRA 2085-6010-00 Crystal Detector, 1-18 GHz, negative polarity, SMA(m/f)	\$50.00
PAMTECH KYG1014 WR42 Junction Circulator, 18.0-26.5 GHz	\$250.00
SONOMA ENG. S-4901 WR15 Junction Isolator, 57-59 GHz, 30 dB isolation	\$125.00
SONOMA ENG. S-4906 WR15 Junction Isolator, 60-62 GHz, 30 dB isolation	\$125.00
SONOMA ENG. S-4907 WR15 Junction Isolator, 62-64 GHz, 30 dB isolation	\$125.00
SONOMA SCIENTIFIC 21A3 WR42 Circulator, 20 dB, 20.6-24.8 GHz	\$75.00
SPACE LABS DQ-1 WR22 Flat Broadband Detector, 33-50 GHz	\$400.00
SPACE LABS K-2X Frequency Doubler, 9.0-13.25 GHz in / 18.0-26.5 GHz out	\$350.00
SPACE LABS KA-3X Frequency Tripler, 8.83-13.33 GHz in / 26.5-40.0 GHz out	\$350.00
TRG 8528 WR22 Direct Reading Phase Shifter, 0-360 deg., 33-50 GHz	\$1,250.00
TRG V551 WR15 Frequency Meter, 50-75 GHz	\$600.00
TRG V551 WR10 Frequency Meter, 75-110 GHz	\$750.00
WAVELINE 100080 WR28 Terminated Crossguide Coupler, 30 dB	\$200.00
WEINSCHTEL 1515 Power Divider, 2-Way, DC-18 GHz, SMA(m/f/f)	\$125.00
WEINSCHTEL DS109 Double Stub Tuner, 1-13 GHz, N(m/f)	\$150.00
WEINSCHTEL DS109LL Double Stub Tuner, 0.2-2.0 GHz, N(m/f)	\$150.00

COMMUNICATIONS

HP 3762A/3763A BER Test System, 1 kHz-150 MHz	\$1,250.00
HP 4935A-003 Transmission Test Set, 20 Hz-110 kHz, battery power	\$1,000.00
HP 59401A HP1B Bus Analyzer	\$700.00
TEK 1410R NTSC Gen., w/SPG2 sync. generator, TSG7 color bars	\$800.00
TEK 1411R PAL Gen., w/SPG12 sync; TSG11 color bars; TSG13 linearity	\$750.00
TEK 1411R PAL Test Gen., w/SPG12, TSG11, TSG13, TSG15, TSG16	\$1,000.00
TEK 1411R PAL Test Gen., w/SPG12, TSG11, TSG12, TSG13, TSG15, TSG16	\$1,100.00
TEK 1411R-opt.04 PAL Test Gen., w/SPG12, TSG11, TSG13, TSG15, TSG16	\$1,400.00
TEK 1420 NTSC Vectorscope	\$600.00
TEK 147A NTSC Test Signal Generator, with noise test signal	\$800.00
TEK 148 PAL Insertion Test Signal Generator	\$700.00
TEK 520A NTSC Vectorscope	\$750.00
TEK 521A PAL Vectorscope	\$750.00

MISCELLANEOUS

P.A.R. 5206-95,98 Two-Phase Lock-in Amp., 2 Hz-100 kHz, GPIB	\$1,500.00
P.A.R. 5209 Lock-in Amp., 0.5 Hz-120 kHz, 130 dB dynamic reserve	\$2,500.00
TEK TM5006 5000-series 6-slot Programmable Power Module	\$600.00
TEK TM504 500-series 4-slot Power Module	\$175.00
TEK TM506 500-series 6-slot Power Module	\$250.00
TEK TM515 500-series 5-slot Traveller Power Module	\$275.00

ELECTRONICS

Q & A

..... With TJ Byers

In this column, I answer questions about all aspects of electronics, including computer hardware and software. This column doesn't replace the Tech Forum that you've grown to love and support. Instead, it will supplement it, so feel free to participate as always with your questions and answers. You can reach me on America Online at TJBYSERS, on the Internet at TJBYSERS@aol.com, or by snail mail at Nuts & Volts Magazine, 430 Princland Ct., Corona, CA 91719.

What's Up:

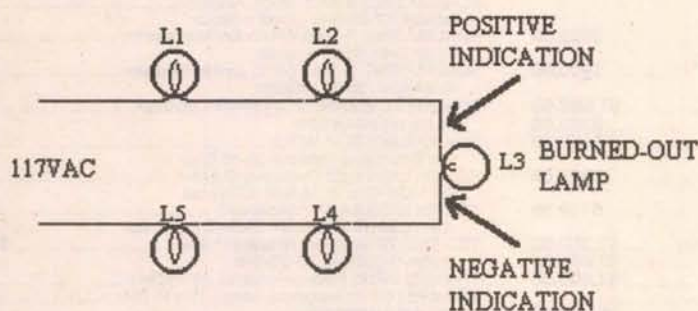
At last: Cut the Christmas burned-out bulb chase using a "magic" wand. Fun stuff: Little Nemo sleeps, simple alarm, and DTMF actuator. More serious: solar basics, MIDI interface, and a couple of power inverters (400 Hz, too). Check out the Mailbag for updates.

Bad-Bulb Locator For The Holidays

Q. I'm looking for a "Handy Tester" like the one advertised in Electronic Goldmine on page 25 of your May '98 issue. Unfortunately, they were all sold out when I called and Goldmine doesn't expect to get more any time soon. Can you guide me in finding such a "tester" somewhere else and does this device really work on Christmas light strings to find the burned-out bulb?

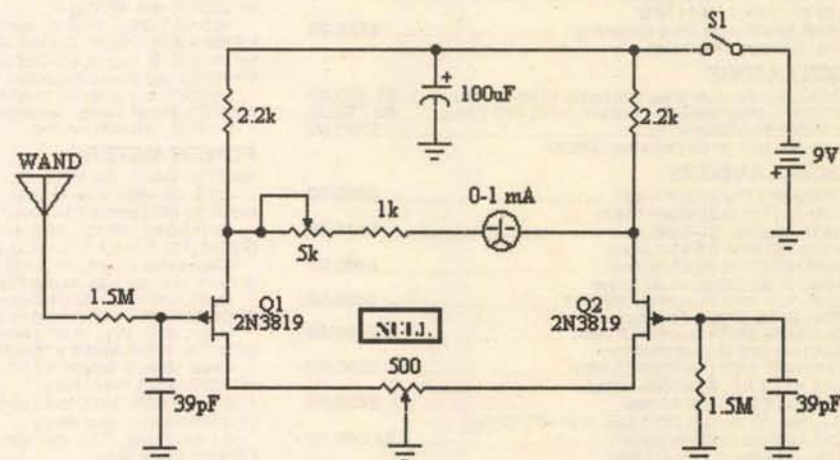
David L. Vrba
Dublin, CA

A. I'm not sure what kind of sensor they used in that device, but if you're just looking for something to locate a break in an AC wire like a burned-out bulb in a Christmas light string or a bad extension cord, an electrostatic detector is just the ticket. To understand how it works, consider a string of bulbs with one burned-out bulb — an open circuit, as shown below.



The intact filaments on either side of the break (bad bulb) complete a continuous circuit from the AC supply to the opposite

sides of the broken filament. The voltage differential between wires leading to any bulb in each leg of the string is zero. However, the differential voltage across the broken filament is ground on one side and 110 VAC on the other. The presence of 110 VAC on one wire produces large electrostatic fields that are easily detected even through plastic insulation. By running an electrostatic detector (antenna) along the length of the string, the defective bulb is easily identified.



Basically, the electrostatic detector is an adaptation of the original "transistorized" voltmeter, which uses two junction FETs in a balanced-bridge network. The gate of Q1 is connected to the antenna wire "wand" while Q2's gate goes to ground. The balance potentiometer sets the meter to mid scale and the gain control sets the sensitivity of the instrument. To use the tester, adjust the balance control for mid-scale reading while standing in the middle of the room. Now with the Christmas light string plugged into an AC outlet, move the wand near the lamp's wires. The needle will swing one way or the other, depending on whether it's closer to ground or the "high" AC side. You may have to adjust the gain control to keep the needle from pegging. Now slide the wand along the wiring string until you notice a definitive swing from one end of the scale to the other. The intervening lamp is the culprit and the burned-out bulb. Don't worry if there's more than one dead lamp in the string. Just keep up the procedure until all defective bulbs are found. Happy Holidays!

Simple Alarm

Q. I have an EOL (End Of the Line) resistor security loop that monitors the perimeter of a storage building. It hasn't been used in a while, and I need to get it up and working again. What I need is a detector that will

5 Axis Robotic Arm Kit \$195.00 Plus S&H

Lynxmotion

We make it easy!

You can build this Robotic Arm! Impressive, fast, accurate, and repeatable motion. Any computer capable of sending 2400 or 9600 baud serial data can control the arm, even a Basic Stamp. This arm makes a great foundation for AI and motion control experiments. Position the arm in an X, Y, Z, grid with a joystick or keyboard using the new RoboMotion for Windows. The kit includes the hardware, structural components, Hitec servos, pre-assembled SSC servo controller, DOS and Windows software, and an illustrated assembly manual. Camouflage paint not included.



We have many more cool robots, check out our web page or ask for our free catalog!
3 Axis Version \$155.00 • Mobile Version \$250.00 • Mobile Robots Book \$48.00

Lynxmotion, Inc.
104 Partridge Road
Pekin, IL 61554-1403 USA
http://www.lynxmotion.com



Tel: 309-382-1816
Fax: 309-382-1254
sales@lynxmotion.com
tech@lynxmotion.com

EPROM+ A DEVICE PROGRAMMER FOR BENCH AND FIELD

A professional system for product design and service!

NEW SOFTWARE!
LATEST DEVICES!

FIRST GENERATION EPROMS (24 PIN) 2708, TMS2716*, 1702*
SECOND GENERATION EPROMS (24,28,32 PIN) 2516,32,64,68764/66, 2716,32,64,128,256,512,513,011,010,101,1001,020,2001,040,4001,080,8001 (40,42 PIN*) 27C210,1024,220,2048,240,4002,4096,27C400,800, 27C160
EEPROMS/NVRAMS (16-32 PIN) X2210/12,2804,16,17,64,65,256,512,010,ER5901,12XXX
FLASH EPROMS (28,32 PIN) [28F] [29C] [29EE] [29F] 256,257,512,001BX,010,101,020,040
SERIAL EPROMS (8 PIN INCLUDES C.C.S.,L.C.E.) [2401] 02,04,08,16,21,32,44,64,65,256 [25010] 020,040,080,160,320,640,128 [59C11] 13,22 [8572] 82,92 [9306] 13,14,46,56,66,86 [95010] 020,040,080 [35C102] 104,108 (14 PIN) ER1400, M58657
BIPOLAR PROMS (16 THROUGH 24 PIN) 82SXXX AND 74SXXX FAMILIES **EPGA CONFIGURATORS** [17C65] 128,256
MICROCONTROLLERS (8 BIT) [8041] 42,48,49 [8741] 42,48,49 [8751] C51,5X,C5XX, 6XX [87C750] 87C751 87C752
ATMEL FLASH MICROPS (8 - 40 PIN) [89C51] 52,55 [89C1051] 2051 [89S8252] 53 [90S1200] 2313, 2323, 2343, 4414, 8515
PIC MICROPS [12CXXX] [16C54] 55,56,57,58,55X [16C61] 62,63,64,65,6XX [16C71] 73,74,71X [16C84] [16F8X] [14000]
MOTOROLA MICROPS [68705P3] U3,R3 [68HC705C8] C9,J2,P9 [68HC711E9] D3
*REQUIRES SNAP-IN ADAPTER (DIAGRAMS INCLUDED OR PURCHASE ASSEMBLED AND TESTED)

□ READ, PROGRAM, COPY, COMPARE, DISK FILE LOAD & SAVE (PLUS MORE!)
□ FULL SCREEN BUFFER EDITOR WITH 25 COMMANDS PLUS BYTE & WORD MODES
□ READS INTEL HEX/EXTENDED HEX, MOTOROLA S-RECORD AND BINARY FILES
□ SOFTWARE RUNS UNDER DOS, WINDOWS 3.1, 95 OR 98 ON ANY SPEED MACHINE
□ PARALLEL PRINTER CABLE AND POWER PACK STORE INSIDE UNIT (9"X6"X3")
□ 1 YEAR WARRANTY - 30 DAY MONEY BACK GUARANTEE

\$289

COMPLETE SYSTEM INCLUDES: PROGRAMMING UNIT, SOFTWARE
PRINTER PORT CABLE, POWER PACK AND PRINTED MANUAL

\$5.00 SHIPPING - \$5.00 C.O.D.
VISA • MASTERCARD • AMEX

ANDROMEDA RESEARCH, P.O. BOX 222, MILFORD, OHIO 45150

(513) 831-9708 FAX (513) 831-7562

website - www.arlabs.com

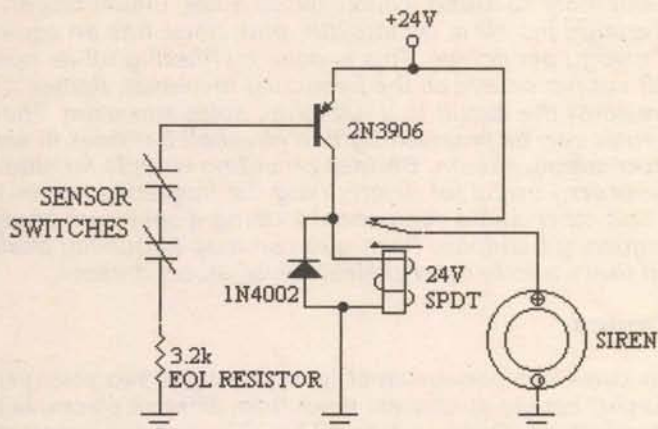
email - arlabs@worldnet.att.net

MADE IN THE U.S.A.

sound a relay-activated alarm when the loop is broken, but restore itself when the break is fixed. The EOL resistance is 3.2K and the power supply is 24 volts. What do you suggest?

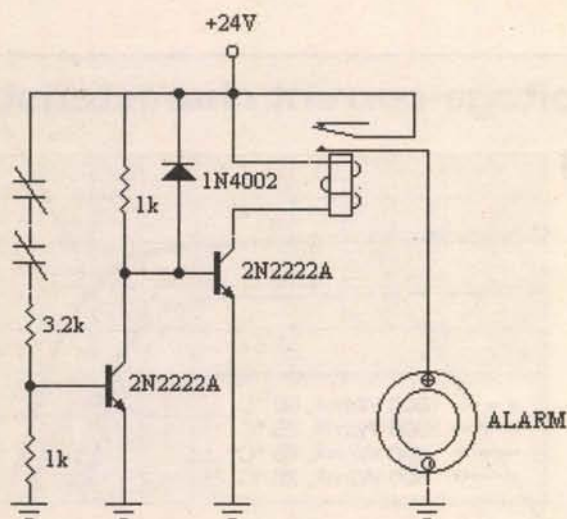
**Larry
via Internet**

A. Something simple with a low part count to keep it reliable – something like this.



The EOL resistor is used to bias the 2N3906 transistor which, in turn, actuates the relay. If the EOL link is interrupted, the relay drops out and the siren sounds. This design is more reliable than having the relay pull in to activate the alarm because it will sound off if the relay, diode, or transistor fails. If we wired it the other way around, where a break in the loop would pull in the relay, a defective transistor or relay would render the alarm worthless.

(Editor's note: Larry thanked me for the circuit, but said that what his boss really wanted is a circuit that draws no relay power until the alarm is tripped. Okay Larry, here it is.)



In this design, Q1 is turned on through the 3.2K resistor when the perimeter loop is secure which, in turn, shorts Q2's base to ground, turning it off, and prevents the relay from energizing. When the loop is broken, Q1 turns off, Q2 turns on, and the relay pulls in, sounding the alarm.

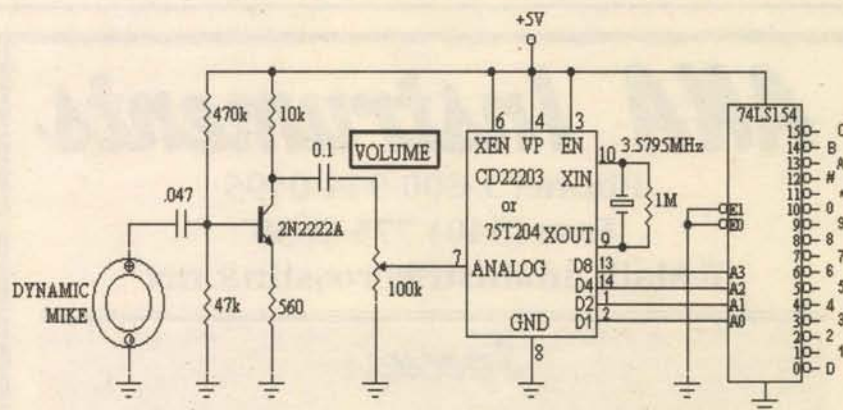
DTMF Decoder

Q. I need a circuit that will take dialing tone frequencies from a telephone earpiece using a microphone, decode the tones, then output the results as 0 through 9 logic outputs. The tones will be used to activate other devices, like room lights.

**Danny Mower
Monroe, NC**

A. A couple of years ago, I would have told you to use 567 tone decoders and lots of logic gates. Today, though, it can be done a lot easier and cheaper using just two ICs and a transistor. The "brains" of this design is a DTMF (Dual Tone Multiple Frequency) receiver: a CD22204 from Harris Semiconductor or the 75T204 from Silicon Systems and TDK Semiconductors. Although the part numbers are different, the chips are identical and interchangeable. You can buy it from Newark Electronics (1-800-463-9275; <http://www.newark.com>) or QuestLink (<http://www.questlink.com/>) for about \$4.00. This chip is a complete DTMF receiver that detects and decodes 16 telephone digits. Each digit is a combination of two frequencies. (Please note that the letters are for special applications and not normally used in telephone dialing.)

Number	Frequency #1	Frequency #2
1	697 Hz	1209 Hz
2	697 Hz	1336 Hz
3	697 Hz	1477 Hz
4	770 Hz	1209 Hz
5	770 Hz	1336 Hz
6	770 Hz	1477 Hz
7	852 Hz	1209 Hz
8	852 Hz	1336 Hz
9	852 Hz	1477 Hz
0	941 Hz	1336 Hz
*	941 Hz	1209 Hz
#	941 Hz	1477 Hz
A	697 Hz	1633 Hz
B	770 Hz	1633 Hz
C	852 Hz	1633 Hz
D	941 Hz	1633 Hz



No front-end filtering is needed (the tone filters are inside the chip), and the only external component needed is an inexpensive TV colorburst crystal (3.579545 MHz) available from Radio Shack (RSU 11321437) and other sources for under \$2.00. The transistor amplifies the low-level signal from the dynamic microphone to be compatible

BUY • SELL • CONSIGN

WANTED

- Electronic Test Equipment
- Electronics Inventory
- Scientific Equipment
- Mfg. Shop Equip.
- Data/Telco
- Memory

9749 Hamilton Road
Eden Prairie, MN 55344

We Sell
Nationally!

Call our Fax-On-

Demand System, or our

Internet site for current availability.

Visit our 25,000 sq. ft. showroom warehouse

M-F 9 to 6; Sat 9 to 5

PHONE: (612) 944-7670

INTERNET: WWW.GO2DEXIS.COM

FAX: (612) 942-9712 • FAX-ON-DEMAND: 1-800-547-4636 X 300

Write in 91 on Reader Service Card.

SATELLITE TV – HACKERS 'BIBLE'!

The SECRETS are REVEALED!

- The principles of security
- Descrambler building blocks
- Smart cards, information wars & stupid mistakes
- Cracking codes (includes DirecTV source code)
- Installing and hooking up descramblers
- Video manipulative systems...and much more...

CALL 800-483-2423

TO ORDER - Send \$60 plus \$4 s/h to:
Baylin Publications, 1905 Mariposa, Boulder, CO 80302
MASTER, VISA & AMEX /COD orders accepted

Telephone: 303-449-4551

FAX: 303-939-8720

E-Mail: fbaylin@baylin.com

FREE CATALOG – Satellite TV books, videos and software

Write in 92 on Reader Service Card.

Nuts & Volts Magazine/December 1998

19

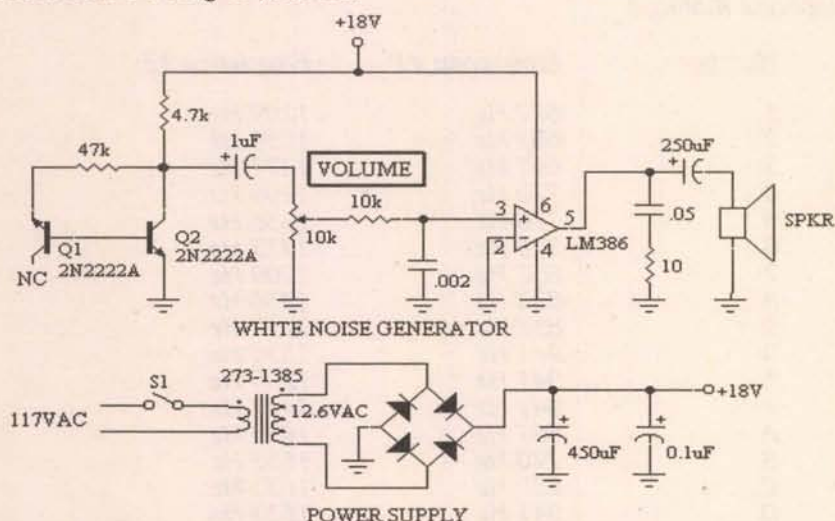
with the receiver's analog input. The tones are analyzed and output in four-bit BCD format, which is further processed by the 74LS154 4-to-16 decoder. When a legal tone combination is detected, the corresponding pin on the 74LS154 goes low – the other pins remain high.

Little Nemo's Slumber Secret (aka White Noise)

Q. I work nights and find it difficult to sleep in the daytime. I understand that there is such a thing as a white noise generator that puts out a sound that would cancel out most of the outside noise. If you know anything about this and could tell me where to find a schematic to build one, I'd really appreciate it.

Roger Nashua, NH

A. Over the centuries, many methods have been tried to guarantee a good night's sleep (or day, as the case may be), everything from magical potions to bewitched poison apples to Perry Como. White noise supposedly overwhelms periodic noise sources which, in turn, blocks out unwanted sounds. Whether it works for you or not remains to be seen. Here's a way to find out.



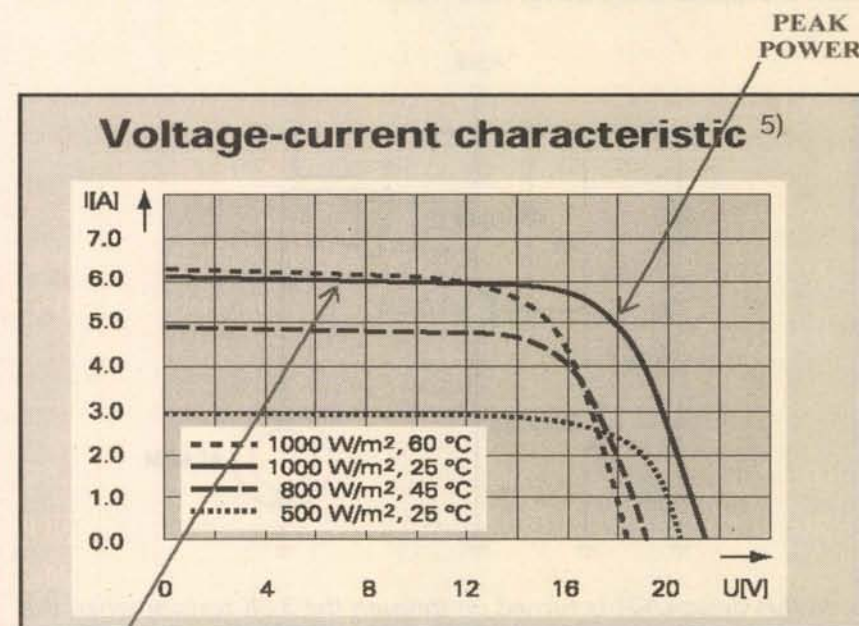
The noise is derived from a zener diode, which is made up of Q1 in the reverse-biased mode. The reversed base-emitter junction of Q1 goes into zener breakdown at about 7 to 8 volts. The zener noise is buffered by Q2 and amplified to speaker volume via the LM386 power amplifier. VOLUME controls the level of the white noise – which isn't really white noise in this design. The inclusion of the .002 uF capacitor across the input of the op amp (LM386) removes some of the high-frequency components to simulate "pink" noise, which is less harsh sounding and more soothing. Unlike white noise, which has an equal amount of energy per Hz of bandwidth, pink noise has an equal amount of energy per octave. This is done by filtering white noise with a 3 dB cut per octave as the frequency increases. Removing the capacitor restores the circuit to a full white noise spectrum. The white noise generator can be powered by two nine-volt batteries in series or the AC power supply shown. Besides providing sounds for slumber, white noise is very useful for determining the frequency response of amplifiers and other audio components. Using a spectrum analyzer or variable-frequency bandpass filter, you can map frequency peaks and valleys, but that's another story. Meanwhile, sweet dreams.

Solar Basics

Q. I recently came into possession of (okay, I bought) two solar panels. They are surplus bought at different times from different places, but appear to be identical. They measure 12 by 12 inches and generate about 13.5 volts in full sun. My question is, how do I determine the amperage of the panels (neither has markings)? I'd like to use the panels to trickle charge a battery using the small load controller/charger you detailed in your "Solar Workshop" column a while back, but I don't know if it can be done.

Andrew L. Ayers via Internet

A. A solar panel is a current source, not a voltage source, as you can see below.



ANA Instruments

Phone: 1-800-944-0495

Fax: (540) 775-9638

E-Mail: anainstr@crosslink.net

Specials

HP 141T CRTs, New in Box	\$195.00
HP 8657A Signal Generator	\$4,500.00
100 KHz-1040 MHz	
HP 8640B Signal Generator	\$2,100.00
Opt. 001, 002, 003	
Gigatronics 600 .01-8 GHz	\$2,400.00
HP 86222A .01-2.4 GHz	\$1,100.00
HP 8903B Audio Analyzer	\$2,700.00
HP 8901B Modulation Analyzer	\$3,700.00
HP 8902A Measuring Receiver	\$17,500.00
HP 436A Power Meter w/Cable	\$1,400.00
Tek 492 Opt 1,2,3 Spec. Analyzer ..	\$6,200.00
Sanders 5440C Noise Figure Meter ...	\$400.00
(new)	

Wanted

RF & Microwave Test and Measurement Equipment & Components

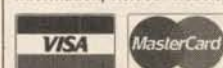
Electronic Test Equipment Bought and Sold
Visa and MasterCard Accepted

MoTron
ELECTRONICS

PO Box 2748
Eugene OR 97402-0280
(541) 687-2118

<http://www.motron.com/>

The Auto-Kall® AK-32 Radio Telemetry/Control Boards are designed for remote control applications where direct wiring is impractical. By implementing a radio interface, the AK-32 offers both a wireless and economical solution. The AK-32 boards work in pairs and can be used for bi-directional control and contact monitoring applications. The AK-32 will work with any FM Communications or Amateur Radio transceiver (Appropriate licenses required.) The AK-32 features 16 inputs and 16 open-collector outputs designed to control 12V relays. Outputs can be connected to any of the MoTron line of Relay Boards. Programming the boards is accomplished with any DTMF source, and will retain the data in the EEPROM until reprogrammed. For additional information, visit our website, or call us at (541) 687-2118.

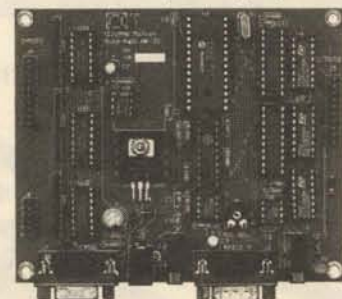


Visa, MasterCard, American Express, Discover and Government Purchase Orders accepted.
S/H: \$8 USA; \$11 Canada; \$16 Foreign.
Se Habla Español. Pida Por Don Moser.

Info: (541) 687-2118

Orders: (800) 338-9058 Fax: (541) 687-2492

\$249.00
plus shipping



Auto-Kall® AK-32
Radio Telemetry/Control Board



ELECTRONIC TEST EQUIPMENT BOUGHT & SOLD

90 DAY WARRANTY PARTS & LABOR • 10 DAY RIGHT OF RETURN, OPEN ACCOUNTS

Alltech 360D11, Frequency Syn. .01-2GHz	\$800	HP 8660C, Freq Syn w/86603A & 86635A, 2.6GHz	\$2,500
Alltech Type 32, Precision Attenuator, 0-100dB	\$300	HP 8672A/01, Signal Generator, 2-18GHz	\$5,000
Argosystems AS210, Frequency Calibration System	\$2,000	HP 8697A, RF Plug-In, 26.5-40GHz	\$250
Bird 4381, RF Power Analyst, Opt. 832	\$200	HP 8743A, Reflection Transmission Test Set	\$200
Boonton 102B, Signal Generator, .45-520MHz	\$500	HP 8743A/018, Reflection Transmission Test Set, 18GHz	\$300
Boonton 518-A4, Q Standard	\$100	HP 8750A, Storage Normalizer, Includes Cable	\$250
Boonton 82AD, Modulation Meter	\$650	HP 8755C, Network Analyzer Plug-In	\$250
Boonton 92BD, Digital RF Millivolt Meter	\$250	HP 8756A, Scalar Network Analyzer	\$1,500
Boonton 4200/4E, Power Meter, 18GHz	\$800	HP 8757A/001, Network Analyzer, Opt. 001	\$4,000
Boonton 4200/4G, Power Meter Sensors, .01-26.5GHz	\$200	HP E3617A, DC Power Supply, 0-40V, 1A	\$250
Boonton 4220/51013, Power Meter, 18GHz	\$800	Keithley 180, Digital Nanovoltmeter	\$200
Boonton 4300, Power Meter w/2-51013 Detectors, Calibrated	\$2,500	Keithley 192, Programmable DMM, 6.5 Digits, HPIB	\$600
Brüel & Kjær 1612, Bandpass Filter	\$250	Keithley 195A, Digital Multimeter	\$300
Calif. Inst. 101T, AC Power Source	\$400	Keithley 614, Electrometer	\$700
Data Precision 6000/611, Waveform Analyzer	\$350	Krohn-Hite 3202, Filter, LP, HP, BP, Unused	\$350
Datron 1062, Digital Multimeter	\$350	Leeds & North 1091, Capacitor Decade, .001uF-1uF	\$150
DR Thiedig MILLI-T02, Ohmmeter, 1 Milliohm-2 Terrahms	\$400	Marconi 6960, Power Meter with 6920 Sensor	\$800
Eaton 380K11, Frequency Synthesizer, 1-2000MHz	\$2,000	Narda 5082, High Directivity Bridge, 2-18GHz	\$300
EIP 371, Source Locking Microwave Counter, 18GHz	\$1,000	Narda 5292 Directional Coupler, 1-18GHz	\$200
ESI 250DE, LCR Bridge	\$200	PMI 1018B, Peak Power Meter	\$350
ESI 296, Auto LCR Meter	\$800	Polarad 1207, Signal Source 3.8-8.2GHz	\$200
Fluke 515A, Portable Calibrator	\$800	Racal Dana 1515, Delay Pulse Generator	\$500
Fluke 6010A, Frequency Synthesizer, 10Hz-11MHz	\$300	Racal Dana 1992, Frequency Counter, High Stab.	\$500
Fluke 6080A/VAN Frequency Syn., .5-1024MHz	\$5,000	Racal Dana 9082P, Signal Gen. 1.5-520MHz	\$600
Fluke 8922A, True RMS Voltmeter	\$250	Racal Dana 9303, True RMS RF Level Meter	\$500
Fluke 9010A, Micro-System Troubleshooter Opt. 001	\$200	Racal Dana 9515, Universal Counter, HPIB, Opt. 41	\$200
Fluke A55, Thermal Converter	\$200	Rohde & Schwarz SPN, Audio Generator	\$300
General Microwave 478A, Peak Power Meter	\$700	Sencore TF30, Super Cricket Transistor Tester	\$200
General Radio 1433G, Decade Resistor	\$350	Tek 1241A, Logic Analyzer, with Accessories	\$650
General Radio 1433G, Decade Resistor, 1.111111m	\$300	Tek 134, Probe Amplifier for P6021 & P6022	\$100
General Radio 1557, Vibration Calibrator	\$400	Tek 1410, Sync Generator SPG2, Color Bars TSG7	\$650
Gigatronics 600/6-12, Synthesized Source	\$1,000	Tek 1420, NTSC Vectorscope	\$500
Gigatronics 600/10-18, Signal Generator, 10-18GHz	\$1,500	Tek 1470, NTSC Color Sync & Test Sig. Generator	\$500
Guideline 9154C, Transvoltage Standard Cell	\$300	Tek 1502, TDR, Opt. 4, Chart Recorder	\$1,000
Guideline 9577, Precision DMM, 7.5 Digits	\$300	Tek 1503/01/05, TDR, Scale in Meters	\$1,000
Hitachi V-212, Scope, 20MHz, Dual Trace	\$200	Tek 178, Linear IC Test Fixture, For 577	\$300
HP 1122A, 100MHz Active Divider Probe, Unused	\$100	Tek 2336, Scope, 100MHz, Dual Trace	\$800
HP 11590A, Bias Network	\$250	Tek 2432, Scope, Digital, 300MHz, 4 Channel	\$2,000
HP 11604A, Universal Extension	\$300	Tek 2445B/10/12, Scope, 150MHz, 4 Trace, HPIB	\$2,000
HP 11605A, Flexible Arm	\$200	Tek 2465, Scope, 300MHz, 4 Channel	\$2,000
HP 11638A, Calibration Kit, Type N	\$600	Tek 305DMM, Scope, 10MHz, Dual Trace, DMM, battery	\$800
HP 11664A/01, Detectors, .01-18GHz	\$200	Tek 4041, System Controller, GPIB	\$200
HP 11665B, Modulator	\$250	Tek 436/022, Power Meter w/8481A, Cable, GPIB	\$1,200
HP 11712A, Service Kit for 8670 Series Inst.	\$500	Tek 464, Scope, 100MHz Dual Trace, Storage	\$400
HP 11869A, Adaptor for Plug-In 8350A/B	\$350	Tek 465, Scope, 100MHz Dual Trace	\$400
HP 1630G, Logic Analyzer, 65 Ch. 100MHz	\$600	Tek 492/02, Spectrum Analyzer	\$4,000
HP 16500A, Mainframe, 16510A, 16530A, 16531A, 16520A, 16521A	\$3,000	Tek 496P, Programmable Spectrum Analyzer	\$4,000
HP 16510B, Logic Analyzer Card, 16500A System	\$500	Tek 5003, Power Module	\$300
HP 16530A/16531A, Digital Scope Card, 16500A System	\$500	Tek 5A13N, Differential Comparator	\$250
HP 214B, Pulse Generator	\$1,000	Tek 5A20N, Differential Amp	\$100
HP 3312A, Function Generator, .1-13MHz, Sweep	\$400	Tek 604, XY Monitor	\$100
HP 3325A, Function Generator	\$1,200	Tek 7D20, Programmable Digitizer PI	\$600
HP 3325A/01/02, Function Gen. Opt. 01/02	\$1,800	Tek AA501, Distortion Analyzer	\$800
HP 3400A, RMS Voltmeter, 10Hz-10MHz	\$200	Tek DC503, Universal Counter Timer TM500	\$150
HP 3455A, Digital Multimeter	\$300	Tek DC504, Counter/Timer TM500	\$100
HP 3456A, Digital Voltmeter, 6.5 Digits	\$600	Tek DM502A, Autoranging DMM	\$150
HP 346A, Noise Source, 10MHz-18GHz	\$500	Tek FG502, Function Generator, .1Hz-11MHz	\$250
HP 3468A, Multimeter, 5.5 Digits	\$400	Tek P6021, Current Probe with Termination	\$100
HP 3580A, Spectrum Analyzer, Opt. 02	\$800	Tek P6046, Differential Probe	\$300
HP 4140B, Picoammeter, DC Source	\$2,000	Tek PG508, Pulse Generator, 50MHz	\$300
HP 4270A, Automatic Capacitance Bridge	\$200	Tek PS503A, Dual Power Supply	\$150
HP 436A/022, Power Meter, HPIB	\$800	Tek SC502, Scope, 15MHz, Dual Trace	\$250
HP 5004A, Signature Analyzer	\$100	Tek SC503, Scope, 10MHz Storage	\$400
HP 5005B, Signature Multimeter	\$350	Tek SC504, Scope, 80MHz Dual Trace	\$500
HP 5006A, Signature Analyzer	\$300	Tek SG502, Sig. Gen. 5Hz-50KHz	\$200
HP 5182A, Waveform Recorder, Generator	\$500	Tek TG501, Time Mark Generator	\$400
HP 5316A, Universal Counter	\$200	Texscan SSG2000, Freq. Syn., 100KHz-2GHz, AM, FM	\$1,800
HP 5328A/021/040, Frequency Counter, DMM	\$250	Valhalla 2000, Auto Digital Watt-Ammeter	\$200
HP 5334A/020, Universal Counter w/DVM	\$800	Vu-Data 5110, Semiconductor Tester, In/out Circuit	\$150
HP 5335A/010, Frequency Counter	\$800	Wavetek 143, 20MHz Function Generator	\$200
HP 5335A/030, Frequency Counter, 1300MHz	\$1,000	Wavetek 1084, Signal Gen. Sweeper, 3.5-4.5GHz	\$300
HP 5340A, Frequency Counter, 18GHz	\$800	Wavetek 180, Sweep/Function Generator	\$200
HP 54100D, Digital Scope, 1GHz	\$2,000	Wavetek 185, Sweep Function Gen. .0001-5MHz	\$400
HP 54200A, Digital Scope, Scope, Dual Trace, 200MG/S	\$1,000	Wavetek 186, 5MHz Phase Lock Generator	\$200
HP 6112A, Power Supply, 0-40V, 0.5A	\$200	Wavetek 1910, XY Monitor, Dual Trace	\$400
HP 8015A, Pulse Generator, .1Hz-50MHz, 30V	\$500	Wavetek 452, Filter, Dual Hi/Low, 1Hz-10KHz	\$450
HP 8165A, Programmable Signal Source, .0001-50MHz	\$1,600	Wavetek 7530A, FFT Spectrum Analyzer 0-100KHz	\$500
HP 8350A/86290B, Sweep Oscillator, 2-18GHz	\$3,400	Wavetek 907, Signal Generator, 7-11GHz	\$600
HP 8350B, Sweep Oscillator Mainframe	\$2,500	Wavetek 955, Micro Source, 7.5-12.4GHz, AM, FM, Sweep	\$1,000
HP 83545A, RF Plug-In, 5.9-12.4GHz	\$1,200	Wiltron 560A, Network Analyzer	\$800
HP 8410C/8412B, Network Analyzer w/8411A/Opt. 18, 18GHz	\$800	Wiltron 560-97A50, SWR Autotester, .01-18GHz	\$500
HP 8411A, Frequency Converters	\$250	Wiltron 610D, Sweeper Mainframe	\$250
HP 8414A, Polar Display	\$300	Wiltron 610D/6237D, Sweep Generator, 2-18GHz	\$800
HP 8445B, Spectrum Anyz., Automatic Pre-Selector	\$300	Wiltron 6213D, RF Plug-In, 10MHz-4.2GHz	\$400
HP 8496B, Attenuator, 110dB	\$250	Wiltron 6219D, RF Plug-In, 2-8GHz	\$200
HP 8553B, Spectrum Anyz., RF Plug-In, 1KC-110MHz	\$200	Wiltron 6223D, RF Plug-In, 4-12.4GHz	\$250
HP 8554B/8552B, Spectrum Analyzer 141T, 1.2GHz	\$1,500	Wiltron 6229D, RF Plug-In, 7.9-18.5GHz	\$300
HP 8557A/180TR, Spectrum Analyzer, .01-350MHz	\$1,000	Wiltron 62FF75, VSWR Bridge, 10-1000MHz	\$150
HP 8559A/182T, Spectrum Analyzer, .01-21GHz	\$2,500	Wiltron 6647A-20/02/03, Programmable Sweep Generator	\$4,000
HP 8559A/853A, Spectrum Analyzer, Digital, .01-21GHz	\$3,500	Wiltron 6NFS0, Autotester, 1-1500MHz, for 640	\$100
HP 8565A, Spectrum Analyzer	\$20,000	Wiltron 7B50, Detector, 1-1500MHz, for 640	\$100
HP 86222B/H69, RF Plug-In, .01-4GHz	\$1,000		
HP 86241A, RF Plug-In, 3.2-6.5GHz	\$400		
HP 86260A, RF Plug-In, 12.4-18GHz	\$400		
HP 86290A, RF Plug-In, 2-18GHz	\$1,200		
HP 86290B, RF Plug-In, 2-18GHz	\$1,400		
HP 8656B, Signal Generator, 1-990MHz, AM/FM	\$3,000		

➔ **INVENTORY CLEARANCE SALE** ➔
SAVINGS UP TO 50%

PHELPS INSTRUMENTS

2631 Hillside Ave., Norco, CA 91760
909-279-7347 • FAX 909-279-7347



Electronics Q & A

connector and five-pin MIDI connectors.

Sound Blaster MIDI/Game Connector

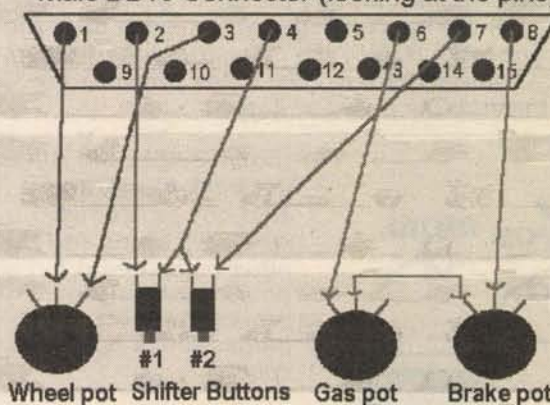
Pin	Function
1	+5V
2	X button for joystick A
3	X potentiometer for joystick A
4	GND
5	GND
6	Y potentiometer for joystick A
7	Y button for joystick A
8	+5V
9	+5V
10	X button for joystick B
11	X potentiometer for joystick B
12	MIDI out
13	Y potentiometer for joystick B
14	Y button for joystick B
15	MIDI in

MIDI 5-pin DIN Connector

Pin	MIDI in	MIDI out
1	N/C	N/C
2	N/C	GND
3	N/C	N/C
4	Current source (+)	Current sink (-)
5	Current sink (-)	Current source (+)

Now for the second part of your question: Interfacing the joystick to the sound card's MIDI/joystick port. You specifically asked for steering and foot pedal controls, which are often used in car games. Okay, here it is.

Male DB15 Connector (looking at the pins)



The steering wheel, which can be cannibalized from a kid's toy car, is connected to a potentiometer that's wired to the joystick 1 X-axis (between pins 1 and 3). Gas and brake pedals are both connected to PC joystick 1 Y-axis (between pins 6 and 8). The pedals are connected in series just like in flight simulator ped-

als. The connection is made so that when both pedals are released, the joystick interface sees about 50K of resistance. When gas is pressed (and brake is kept up) the resistance increases. When the brake pedal is fully pressed and gas pedal is released, the pedal's system gets the minimum resistance. This prevents you from accelerating when both the brake and gas pedals are to the metal. The shift buttons are standard PC joystick 1 buttons. For more detailed wiring diagram of steering wheels and pedals, check "Build Your Own Wheel & Pedals" article from Wally's World (<http://www.oz.net/~wottenad>), "How To Build Rudder Pedals (for little money)" from <http://me.ritbbs.unimaas.nl/Fun/pedals/pedals.htm>, and Lew's Wheels Web page (<http://www.monmouth.com/~lw4750/index.html>).

400 Hz On The Move

Q. Where can I find a source for a 120V, 400-Hz power supply? Or what modifications can I make to an existing power supply to get the 400 Hz? I've seen a couple articles on this, but they were too vague to be of any help.

Michael Duc via Internet

A. There are only two places you'll find 400-Hz equipment: avionics and military. Unless you have a stash of old WWII military surplus, my guess is that your application is for avionics. A suitable 125-watt, 400-Hz solid-state inverter for avionics is going to cost you \$1,300.00 or more — and they're not easy to find. Here are two contacts.

KGS Electronics

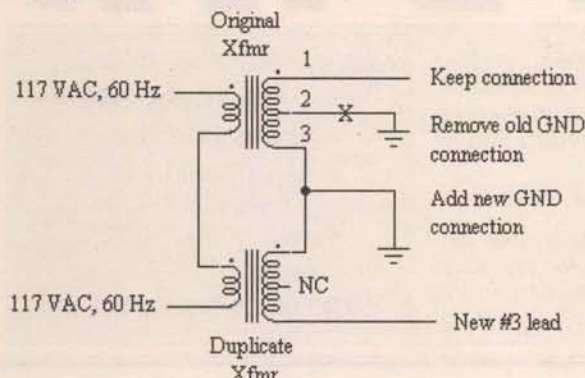
626-574-1175
<http://www.kgselectronics.com>

Zzap Power Corp.

514-369-4919
<http://www.zzap.com>

If the power source isn't too critical, in that it can tolerate a squarewave input instead of pure sine, the circuit in the "Lightweight Power Inverter" circuit above can be modified for 400Hz operation. Simply change the value of the 1 μ F capacitor to 0.15 μ F. You can use the same transformer. While the frequency won't be spot on, it should be close enough for all but the most critical applications. Furthermore, you can fine tune the frequency by adjusting the value of the 12K resistor up or down.

If you're trying to power surplus old 400-Hz WWII equipment from 60 Hz, here's a trick we used back in the "old" days.



Wire two 400-Hz power transformers in series, as shown, and run them from 60 Hz. The benefit of 400-Hz line operation is that the transformers use smaller iron cores — a definite weight advantage for avionics and soldiers on the march. The problem is that when you try to run these trans-

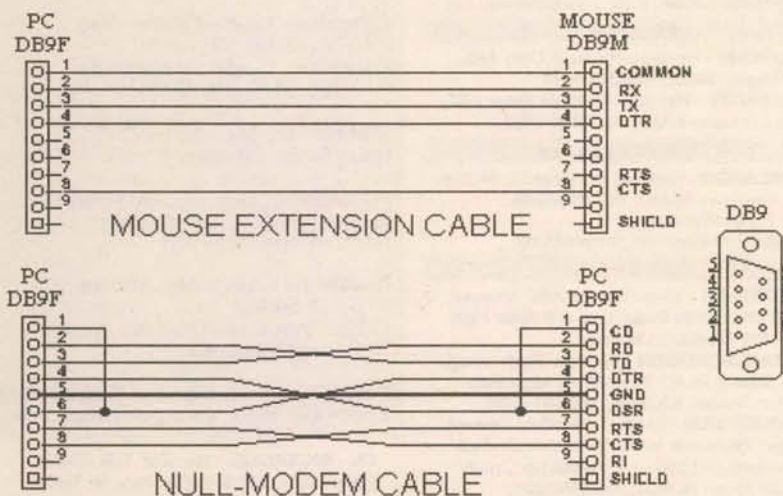
formers off 60 Hz, they get VERY hot! By wiring two 400-Hz power transformers in series, you reduce the voltage across each by half and double the iron content. Ta-da! A working solution. The catch is you need two identical power transformers, which we used to steal from a "dead" relative of the same, and you need to find a place to mount the new transformer in the surplus device. Multiple-secondary transformers need to have this modification made for each winding. Alternatively, you might be able to find an affordable military surplus 400 Hz dynamo (motor generator) from <http://www.surplustuff.com/misc.html>.

Not A Dumb Mouse, A Null Modem

Q. I need to add an extension to my mouse. I've tried two different extension cords, and neither works. All I got is a message saying "mouse not installed." What's up?

Anonymous
via Internet

A. Even though there are many different mouse protocols and different connectors, the extension should work if it's a pass-through cable.



In essence, if pin 1 of the input goes to pin 1 of the output and pin 2 goes to pin 2, nothing changes. What I suspect is that you have a nine-pin mouse connector (DB9) that you're trying to extend using a conversion cable, like a null modem. In a null-modem cable, at least two of the wires are reversed, as shown above. Null-modem cables are plentiful and sell for about \$5.00, which is probably what you thought was an extension cable. What's a null modem cable, you ask? It lets you connect one PC to another PC using regular communications software without going through POTS (plain old telephone system) wires. Think of it as a one-on-one local area network (LAN). Extension cables (which are clearly labeled as such) are plentiful and cheap, too, but building your own has its merits. Using a couple of DPDT switches, you can even make a universal extension/null-modem cable as one. Think about it. Quiz on Monday.

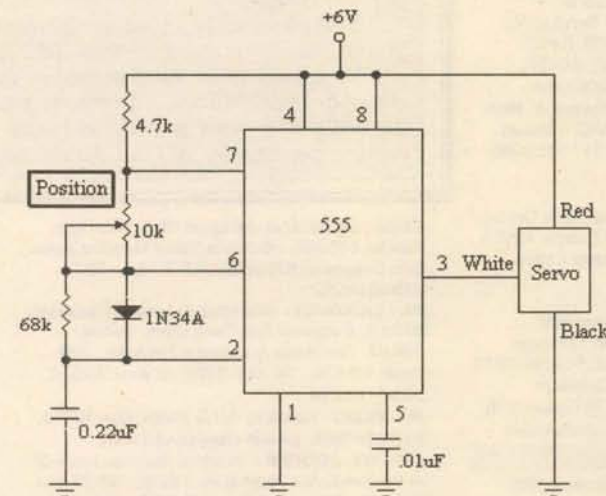
Servo Controllers ... Again

Q. I was wondering if I could ask you about the "Simpler Servo Controller" in the Oct. '97 issue? I've constructed this circuit several times, and tried it with a variety of servos. Although the servo hums (indicating a pulse is

coming through), it doesn't move, and after a short while the 555 heats up. I'm using a regulated five-volt power supply to drive the circuit. Do you know if this circuit actually works? I've seen other circuits on the Web that claim to control servos, but only vary frequency, not pulse width. I have managed to control servos using circuits I've found on the Internet, but they only provide about 45 degrees of rotation. There has GOT to be a simple servo controller circuit out there that works! Any idea where I can get one? I've been searching like mad.

Walt Noon
via Internet

A. I never built the circuit that the reader submitted in the Reader's Tip section of that issue, but it should work. You might want to play with the values of the 39K and 220K resistor to fine tune the response timing. Meanwhile, here's a circuit that I have built and tested — and it works.



The pulse width varies between 1 ms and 2 ms for the left and right extremes, which can span anywhere from 160 degrees to 270 degrees, depending on the servo; a 1.5 ms pulse centers the sweep. The width of the pulse is adjusted by the 10K Position potentiometer. This pulse repeats every 20ms, for a repetition rate of about 50 Hz (servos typically operate between 20

Hz and 80 Hz). The 1N34A is a pulse-shaping diode that sharpens the fall time. The red and black servo leads are power, and the white lead from the servo is the control lead. Have fun!

MAILBAG

Dear TJ Byers:

About the LM558 timer IC in the Sept. '98 column, this chip may be "long obsolete" but there are many uses for this timer. It's available through **Tech America (1-800-877-0072; <http://www.techam.com>)** for just \$0.87. You can find typical applications for this chip in the *Radio Shack Engineer's Notebook II* on pages 102 and 103. I hope Phil Clock and other experimenters can use this information.

Raymond Sylvester
North Branford, CT

Response:

Yes, rumors about the death of this chip are premature. **Philips Semiconductor (1-800-234-7381; <http://www.semiconductors.philips.com>)** still makes them under the name NE558N. You can download the NE558 data sheet from **QuestLink (<http://www.questlink.com>)** and order the part from their Engineer's SuperStore on the Web site.

TJ Byers
Q & A Editor

Dear TJ:

After reading your answer to "Ring Me Up Sometime" I thought that you might like a possible answer to the secret number for calling oneself back. In our area, northern California, we simply call our own seven-digit phone number and get a busy signal. We then hang up and about five seconds later the phone company rings us back. We use this method as an intercom and I believe it's free. Our phone repair person freely told us about this method, and I believe you can call a phone representative and get the same answer if you just ask.

Chris
Bieber, CA

Response:

I've received several letters like this from across the country, and I'm sure it works for many locations. It certainly worked when I lived in southern California. However, it won't work if you have voice mail or call waiting. I now live in northern California, but when I called my local representative (Pac Bell) and repair service (611) about a call-back service before answering the reader's question, they denied its existence. Fortunately, my Telecom repair lady (cable, not Pac Bell) knew the number and was more than willing to spread the word. So much for a kinder, gentler phone company.

TJ Byers
Q & A Editor

Events

CALENDAR

DECEMBER 1998

DECEMBER 5

AL - DOTHAN - Hamfest. Wiregrass ARC, Cheryl Tucker KD4BWE, 334-677-7485
CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

FL - OKEECHOBEE - Hamfest. Okeechobee ARC, Al Berryman AD4RZ, 941-467-0516. E-Mail: ad4rz@juno.com

GA - CLAXTON - Hamfest. Veterans Community Center, Hwy. 280 W. VE Exams. Talk-in: 147.075+.

GA - CLAXTON - Hamfest. Veterans Community Center, Hwy. 280 W. VE Exams. Talk-in: 147.075+. Claxton AR Emergency Service, Mr. Ellie Waters WB4CJB, 912-653-4939. E-Mail: ellie@premierweb.net. Wes Kennedy KU4SR, 912-739-2047. E-Mail: ku4sr@mci2000.com

IL - JACKSONVILLE - Hamfest. Turner Jr. High School. VE Exams. Jacksonville ARS & Illinois Valley ARC, Tim Childers KB9FBI 217-245-2061. E-Mail: kb9fbi@fbi.net

Web: <http://www.qsl.net/k9jx>

LA - MINDEN - Christmas Hamfest. Civic Center, 520 Broadway. 8:30am-3pm. VEC Exams. MARA repeater 147.300+. MARA, Inc., Dusty Collins KB5WFE, 318-371-0636.

E-Mail: dustyc@prism.net

Web: <http://www.norwesla.com/mara.htm>

MN - GOLDEN VALLEY - Hamfest. Courage Handi-Ham System, Nancy Meydell, 612-520-0512

NC - GREENSBORO - Hamfest. Coliseum Special Events Center. 9am-3pm. 76 Group, 336-851-1676. <http://www.sabwc.com/gsohamfest>

DECEMBER 6

CA - LIVERMORE - Hamfest. Livermore ARK, Cliff Kibbe KF6EII, 209-835-6715. E-Mail: larkswap@hotmail.com

DECEMBER 12

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

FL - LAKE CITY - Hamfest & Computer Show. Columbia County Fairgrounds, SR 247, Gateway to FL #4. Columbia ARS, Joe Aymond WD4EOJ, 904-935-2405 6-10pm. E-Mail: wd4eoj@isgroup.net or Colin Boutwell WA5RKR, 904-755-7960. E-Mail: wa5rkr@isgroup.net

SC - UNION - Hamfest. National Guard Armory, Industrial Park Rd. 8am-2pm. Talk-in: 145.250+. Union County ARC, Roger Gregory KI4RG, 864-427-1462. E-Mail: rggregory@carol.net

DECEMBER 19

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

JANUARY 1999

JANUARY 2

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

TN - MORRISTOWN - Hamfest & Computer Show. Talley Ward Recreation Bldg. Talk-in: 147.303+ & 53.030-. Lakeway ARC, Perry Hensley N4PH, 423-828-4848. E-Mail: n4ph@juno.com. Kemp Lawson KF4AGB, 423-587-3320. E-Mail: kemplawson@aol.com.

Web: www.usit.net/mfawbush/larc.html

JANUARY 9

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

CO - LOVELAND - Superfest. Larimer County Fairgrounds, 700 Railroad Ave. 9am-3pm. VE Exams. Talk-in: 145.115- or 146.85-. Northern CO ARC, 970-352-5304

NY - MARATHON - Hamfest. Skyline ARC, Patrick Dunn KC2BQZ, 315-468-5909

SC - GREENWOOD - Hamfest & Computer Show. Greenwood Civic Center, 1610 Hwy. 72 E. 9am-5pm. FCC exams. Talk-in: 147.165+ (open) alternate: 146.52 simplex. Greenwood ARS, Frank Kolar WA9FWO, 864-229-5639.

Web: <http://www.w4gwd.org>

WI - WAUKESHA - Hamfest. Waukesha County Expo Center Forum. 8am-2pm. West Allis RAC, Phil Gural W9NAW, 414-425-3649

JANUARY 9-10

FL - FT. MYERS - Hamfest. Sat: 9am-3pm, Sun: 9am-2pm. Talk-in: 146.880. Ft. Meyers ARC, Colleen Sammons KQ4TR, 941-936-1431. E-Mail: csammons@juno.com

JANUARY 10

IN - SOUTH BEND - Hamfest. The Century

24 December 1998/Nuts & Volts Magazine

The Events Calendar is a free service for publicizing electronic events such as amateur radio hamfests, flea markets, etc. If your organization is sponsoring an event and would like a free listing, contact us at least 60 days in advance. Include your flyer, estimated attendance, name of the person to contact, and phone number.

Complimentary issues are available upon request for distribution to your attendees. A street address for UPS is required.

While we strive for accuracy in our calendar, we can not be responsible for errors or cancellations. The information contained in this column is for the use of the readers of *Nuts & Volts* and may not be republished in any form without the written permission of T & L Publications, Inc.

All listing information should be sent to:

Nuts & Volts Magazine

Events Calendar

430 Princeland Court

Corona, CA 91719

Phone 909-371-8497

Fax 909-371-3052

E-mail events@nutsvolts.com

CA - SANTA ANA - Swapmeet. ACP parking lot. Mary Russo 714-558-8813

MD - ODENTON - Hamfest. Maryland Mobileers ARC, Bill Ziegler KA6TYY, 410-987-2384. E-Mail: ka6tyy@juno.com

FEBRUARY 1999

FEBRUARY 6

AR - WEST MEMPHIS - Hamfest. Dixie AR Group, Kellye Farris KB5RCE, 870-732-8724. E-Mail: kb5rce@media-two.com

Web: <http://www.media-two.com/DARG>

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

SC - NORTH CHARLESTON - Hamfest. Stall High School. 8:30am-4pm. VE Exams. Charleston ARS, Jenny Myers WA4NGV, 843-747-2324. E-Mail: brycemyers@aol.com

FEBRUARY 6-7

FL - MIAMI - Tropical Hamboree. Fair Expo Center, S.W. 112th Ave. & Coral Way. VE Exams. Talk-in: 146.925, 146.76, 444.525. Dade Radio Club of Miami, Evelyn Gauzens. 305-642-4139. E-Mail: edg@elink.net. 305-226-5346. E-Mail: wd4sfg@bellsouth.net. Web: www.hamboree.org

FEBRUARY 7

OH - LORAIN - Hamfest. Northern Ohio ARS, Mike Willemin WB8U, 440-324-4574

PA - LATROBE - Hamfest. Chestnut Ridge ARC, William Demosky K3AFS, 724-539-1552

FEBRUARY 12-13-14

FL - ORLANDO - Hamfest. Northern FL Section Conv., Tim Starr AE4NJ, 407-850-9258. E-Mail: AE4NJ@aol.com

Web: <http://www.oarc.org/hamcat.html>

FEBRUARY 13

CA - FONTANA - Inland Empire ARC Amateur Radio & Electronics Swapmeet. A B Miller High School. Bill 909-822-4138 eves

MA - MARLBOROUGH - Hamfest. Marlborough Middle School, Rt. 85. 10am-2pm. Algonquin ARC, Ann Weldon KA1PON, 508-481-4988

NY - WESTFIELD - Hamfest. Westfield Exempt Volunteer Fireman's Assn., 75 Bourne St. 8am-3pm. Talk-in: 145.350 (-). Chautauque County RAs, Eric Kroon N2PCQ, 716-595-3220. E-Mail: ekroon@netsync.net

FEBRUARY 14

OH - MANSFIELD - Mid*Winter Hamfest & Computer Show. Richland County Fairgrounds. Talk-in: call W8WE on 146.34/94. InterCity ARC, Inc., Pat Ackerman N8YOB, 419-589-7133 after 2pm EST.

FEBRUARY 20

AR - RUSSELLVILLE - Hamfest. AR River Valley AR Foundation, Margaret Alexander KC5MCS, 501-968-7270. E-Mail: ealexand@cswnet.com

CA - SANTEE - ARC of El Cajon Ham, Computer & Electronic Swapmeet. Santee Drive-in. 619-561-0052

FL - BROOKSVILLE - Hamfest. Spring Hill VFW Post 10209, Spring Hill Dr. between US 41 & Mariner Blvd. Talk-in: 146.715. Hernando County ARA, Ralph Wilson AF4FC, 352-754-9653. Jim Angello KE4SZP, 352-688-5214. E-Mail: jangello@fiber-net.com

Web: www.fiber-net.com/pub/hcara/index.htm

MN - BLAINE - Hamfest. Robbinsdale ARC, Jerry Dorf N0FWG, or Harriet Johanson 612-537-1722. E-Mail: jerryd@skypoint.com

COMPUTER SHOWS

AGI Shows, 317-299-8827. E-Mail: info@agishows.com <http://www.agishows.com>

Blue Star Productions

612-788-1901

<http://www.supercomputersale.com>

Computers And You, 734-283-1754.

www.a1-supercomputersales.com

Computer Central Shows

847-412-1900 & 1-888-296-6066.

E-Mail: compcent@megsnet.net

www.computercentralshows.com

Five Star Productions

810-890-0988 E-Mail: jeff@fivestar

www.fivestarshows.com

Georgia Mountain Productions

706-838-4827.

E-Mail: gamtnpro@blrg.tds.net

www.georgiamountain.com

Gibraltar Trade Center, Inc.

734-287-2000. Taylor, MI.

Gibraltar Trade Center, Inc.

810-465-6440. Mt. Clemens, MI.

MarketPro, Inc., 201-825-2229

<http://www.marketpro.com>

MarketPro, Inc., 301-984-0880.

E-Mail: md@marketpro.com

<http://marketpro.com>

Northern Computer Shows

978-744-8440

E-Mail: inquiries@ncshows.com

Web: ncshows.com

Peter Trapp Computer Shows, 603-

272-5008. Web: www.petertrapp.com

OR - RICKREALL - Hamfest. Polk County

Fairgrounds, 520 S. Pacific Hwy. W. Talk-in:

146.86-. Salem Repeater Assn. and Oregon Coast

Emergency Repeater, Evan Burroughs N7IFJ,

503-585-5924 before 8pm.

E-Mail: n7ifj@teleport.com

Web: <http://sra.goldcom.com/sraflyer.htm>

FEBRUARY 21

MI - FARMINGTON HILLS - Swap 'n Shop.

William M. Costick Activities Center, 28600

Eleven Mile Rd. 8am-3pm. Talk-in: 145.350-

repeater and 146.52 simplex. Livonia ARCs,

734-261-5486. E-Mail: swap@larc.mi.org

Web: www.larc.mi.org

NC - ELKIN - Hamfest. Briarpatch & Foothills

ARCs, Jimmy Holbrook KB4GKI, 336-957-3820.

E-Mail: kb4gki@aol.com Web:

<http://members.aol.com/kb4gki/kb4gki.html>

FEBRUARY 27

KY - CAVE CITY - Hamfest. Mammoth Cave

ARC, 502-651-2363. E-Mail: lbrumett@glasgowky.com

Web: <http://www.scrct.blue.net/mcarc>

VT - MILTON - Convention. RAs of Northern VT,

Mitch Stern W1SJ, 802-879-6589. E-Mail:

w1sj@vblmail.champlain.edu Web:

<http://www.ranv.together.com>

CALL TOLL FREE
(800) 292-7711 orders only
Se Habla Español

C&S SALES

EXCELLENCE IN SERVICE

CALL OR WRITE FOR OUR
NEW FREE 64 PAGE
CATALOG!
(800) 445-3201

REPAIR SYSTEM SOLDERING AND DESOLDERING Model SL-916

Top-of-the-line repair system will handle desoldering. Temperature controlled soldering from 300°F to 790°F (150°C to 420°C), desoldering temperature range 410°F to 900°F (210°C to 480°C). The system is based on principle of vacuum absorption of the solder from the PC board.

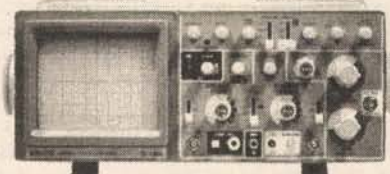
SL-928 - Desoldering System with Digital Display also available. \$325.00



\$425.00



Elenco Scopes Free Dust Cover and Probes



S-1325	25MHz		\$325
S-1330	25MHz	Delayed Sweep	\$439
S-1340	40MHz		\$475
S-1345	40MHz	Delayed Sweep	\$569
S-1360	60MHz	Delayed Sweep	\$749
S-1390	100MHz	Delayed Sweep	\$895

DIGITAL SCOPE SUPER SPECIALS

DS-203	20MHz/10Ms/s Analog/Digital	\$695
DS-303	40MHz/20Ms/s Analog/Digital	\$895
DS-603	60MHz/20Ms/s Analog/Digital	\$995

Four Functions In One Model MX-9300



Features:

- One instrument with four test and measuring systems:
 - 1.3GHz Frequency Counter
 - 2MHz Sweep Function Generator
 - Digital Multimeter
 - Digital Triple Power Supply - 0-30V @ 3A, 15V @ 1A, 5V @ 2A

\$459.95

NEW

Tektronix DMMs

- 40,000 count
- High Accuracy
- Tektronix quality
- 3yr warranty

DMM 912	\$169	\$179
DMM 914	\$239	\$229
DMM 916	\$265	\$275



20MHz Sweep / Function Generator with Frequency Counter Model 4040

- 0.2Hz to 20MHz
- AM & FM Modulation
- Burst Operation
- External Frequency counter to 30MHz
- Linear and Log sweep



10MHz Model 4017	\$309
5MHz Model 4011	\$239

\$399

Fluke Scopemeters



123...NEW...	\$950
92B	\$1445
96B	\$1695
97	\$1695
99B	\$2095
105B...NEW...	\$2495

ALL FLUKE
PRODUCTS
ON SALE

Technician Tool Kit

Model TK-1500

28 tools plus a DMM contained in a large flexible tool case with a handle ideal for everyone on the go.



\$49.95

Fluke Multimeters

Model 26III	\$195	Model 12	\$84
Model 70III	\$85	Model 83	\$235
Model 73III	\$115	Model 85	\$269
Model 75III	\$139	Model 87III	\$299
Model 77III	\$154	Model 863E	\$475
Model 79III	\$175	Model 867BE	\$650

B&K Precision Multimeters

Model 389	\$109	Model 388A	\$99
Model 390	\$127	Model 2707	\$75
Model 391	\$143	Model 2860A	\$79
Model 5360	\$195	Model 5370	\$219
Model 5380	\$265	Model 5390	\$295

DIGITAL LCR METER

Model LCR-1810

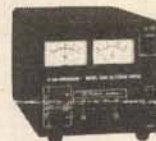
- Capacitance .1pF to 20MF
- Inductance 1μH to 20H
- Resistance .01Ω to 2000MΩ
- Temperature -20°C to 750°C
- DC Volts 0 - 20V
- Frequency up to 15MHz
- Diode/Audible Continuity Test
- Signal Output Function
- 3 1/2 Digit Display



\$99.95

B&K High Current DC Power Supply

- Variable 3-14 VDC
- Thermal Protection
- Current Limiting

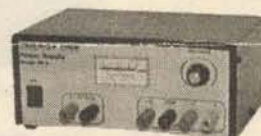


Model 1686 12A	\$159
Model 1688 25A	\$239

B & K 13.8V Fixed DC/Power Supplies	
Model 1680 6A	\$39
Model 1682 15A	\$75

Quad Power Supply Model XP-4

4 Fully Regulated DC Power Supplies in One Unit
4 DC voltages: 3 fixed - +5V @ 1A, -5V @ 250mA, +12V @ 500mA • 1 Variable 0-12V @ 500mA



\$29.95

Digital Multimeter Model M-1740

\$39.95

Free Holster

11 functions including freq to 20MHz, cap to 20μF.
2 Year Warranty



Family Radio Model FRS-14 by Standard

- 1 Mile Range
- 1/2 Watt Output, 14 Channels
- LCD Channel & Code Display
- 38 Selectable Channel Codes
- Back-Lit Display
- No License Required!

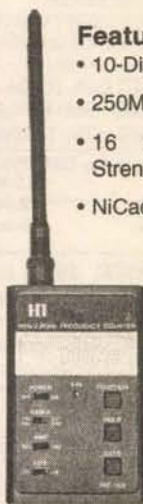
\$129.95 each or
2 for \$250.00



Handheld Universal Counter

Features:

- 10-Digit LCD Display.
- 250MHz Direct Count.
- 16 Segment & RF Signal Strength Bargraph.
- NiCad Battery Included.



Model F-2800 1MHz - 2.8GHz

\$99

B&K Spectrum Analyzers



500MHz Series

BK2615A	*1250
BK2620A	*1675

- 150KHz to 500MHz
- Dynamic Range 80dB (113dB with attenuation)
- +20dBm maximum input
- 12.5 and 400KHz resolution bandwidth
- 150KHz/hour stability
- Built-in tracking generator (Model 2620A)

1.05GHz Series

BK2625A	*1925
BK2630A	*2595

- 150KHz to 1,050MHz
- Dynamic Range 80dB (113dB with attenuation)
- AM & FM demod included
- 20 and 400KHz resolution bandwidth
- 150KHz/hour stability
- Built-in tracking generator (Model 2630A)

Simm Module Tester B&K Precision Model 898

- Tests 72 and 30 pin SIMMs to 36 bits.
- Stands alone and portable. No other equipment required.
- Automatically identifies width, depth and speed of SIMMs.
- 10 built-in tests identify most memory defects Pre-heat cycle prior to tests.



\$625

Model XP-581

4 Fully Regulated DC Power Supplies in One Unit
4 DC voltages: 3 fixed - +5V @ 3A, +12V @ 1A, -12V @ 1A
1 Variable - 2.5 - 20V @ 2A



\$89.95

Portable Semiconductor Tester B&K Precision Model 510

- In or out-of-order circuit tests for transistor, FETs, SCRs and darlings.



\$199

Satellite Finder Model SF-01

- Aligns Satellite Dishes
- Range 950-2050MHz
- Compact Size
- Self Power Check



\$39.95

Dual-Display LCR Meter w/ Stat Functions B&K Model 878

\$219.95

Auto/manual range
Many features
with Q factor
High Accuracy



Digital Audio Generator SG-9300

\$175

- 10Hz - 1MHz
- Low Distortion
- Sine/Square waves
- Built-in 150MHz Frequency Counter



Guaranteed Lowest Prices

C&S SALES, INC.

15 DAY MONEY BACK GUARANTEE

FULL FACTORY WARRANTY

UPS SHIPPING: 48 STATES 5%
OTHERS CALL FOR DETAILS
IL Residents add 8.25% Sales Tax

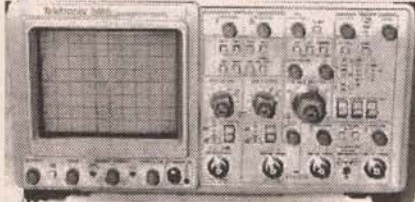
150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: (847) 541-9904 (847) 541-0710
http://www.elenco.com/cs_sales/



PRICES SUBJECT TO CHANGE WITHOUT NOTICE

HAPPY HOLIDAYS TO ALL

TEKTRONIX 2465A, 4 Chan., 300MHz, O'Scope on screen ALPHANUMERIC READOUT of waveform stats.



One of the most popular & powerful scopes available at a reasonable cost. Features: 500ps/Div sweep, 2mV/Div. vertical sensitivity, 1Mohm / 50-ohm input, 500MHz

trigger bandwidth, four channels. On-screen waveform cursors provide vert. & horiz. scale factors, trigger level, voltage, time, freq., phase, ratio values and mode indication. Complete with 2 probes, pouch, cover and manual.

Mint condition. Calibration and 90 day warranty. **\$2295.00**

TWO MINI C-MOUNT CAMERAS, The super sensitive, GM410 or the general purpose GM412, The GM-412 specs: B&W.



size 1.5"sq. X 2.4"L, 250,000 Pixels, 380 Lines Resolution, Sensitivity 0.3 Lux, The GM410 specs: size only 1.5" SQ. x 1.6"L, >270,000 Pixels, 410 Lines Res., Sens. 0.05 LUX. Both cameras are 1/3" CCD with AGC & Electronic shutter. 12V @110mA power. NTSC out. IR SENSITIVE. BNC video out. Both use std. DC pwr.

jack. Aluminum housings with dual threaded top and bottom mounting. True performance not hype! These cameras will outperform ANY camera in this magazine. Multi-lens options are available to exploit their superior performance. **GM412, less lens..\$119, GM410, less lens..\$169**

C-MOUNT LENS OPTIONS to ENHANCE YOUR IMAGE: Fast Lenses for Low Light or General Purpose Normal Light

16mm, f1.6, 15° FOV	\$39	4mm, 80° FOV	\$24
8mm, f1.3, 40° FOV	\$49	8mm, 40° FOV	\$24
4mm, f1.4, 78° FOV	\$49	12mm, 28° FOV	\$24

Exclusive LAB STYLE, class 3A, LASERS, 650nm or 635nm, Rugged & dependable. with a 1 year warranty. Adjustable X & Y beam position. Aircraft aluminum housing. Internal battery (included) rear push on, push off switch. AR coated end window. Shock protected. 75diam. x 2.75"L

650nm \$69 or 635nm \$99

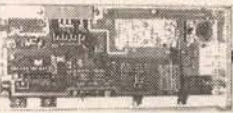
SUPER! UNDERWATER (60 ft.) "LIPSTICK" CAMERA with INTEGRAL INFRA-RED ILLUMINATOR!



Sleek black anodized, BRASS, housing is O-Ring sealed & WATERPROOF. Adjustable mount included. Specs: 1/3" CCD, 400 Lines resolution, 0.05 Lux sensitivity, AGC, Auto Shutter. Operates on 12VDC @225mA, 3.6mm, 92° FOV lens. A real glass lens. NTSC video out. Superior construction. SENSITIVE to IR. Ultra small Size only:

1.25" diam. X 2" long. With 60 ft. cable. Great for general outdoor use also. REG. \$299, **GM-300KIR.....\$219**

900 MHz @FIFTY Watts!, RF POWER AMPLIFIER, MICROWAVE PWR. DEVICES, CPA9093



Beautifully constructed commercial grade CDPD system amp. 0dbm input for full output. Maximum output is adjustable in 4db steps from 19dbm to 47dbm. (3 bit TTL

control). 26VDC @ 7A max. power. Built on a finned heat sink 11" x 5". Overall height is 2.5". VSWR in = 1.5:1, VSWR out = 1.8:1, TTL Bias ON-OFF control, Internal reflected and forward pwr detector analog outputs. Auto thermal overload protection with TTL signal. 10CFM Air flow required at full output. SMA input connector with N type output. Cover removed for photo. **Special...\$129 2 for \$199**

NEWPORT, 495A MOTORIZED, ROTARY STAGE,

Bidirectional 360° continuous rotation, 0.001° res. Integral DC motor & encoder. Load independent velocity servo. Mount in any orientation. Capacity: 55lbs. Size: 4.75"x5"x1.35" With 2" c clear aperture. **Reg. \$2141, Our Price..\$795**

MINI MOTORIZED MOUNTS, ROTARY & LINEAR,

The mini slide (shown left) provides: 2.4" of travel for it's 1" x 1" alum. plate riding on two 0.18" diam steel rods. Motion is via a toothed belt drive from a 1.8" per step, 8 ohm stepper motor. 1 full step ~ about 0.008" of travel. Overall size: 6"L x 3.5"W x 2.5"H, Dual optical end of travel sensors. Alum. construction. **\$29 or 4/\$99**

MINI ROTARY DRIVE with on board LINEAR SLIDE,

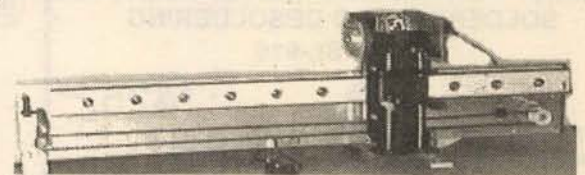
Provides 300° rotation between removeable stop. Rotates continuously with-out stop. 2 optical position sensors for start & end. Same stepper as above. Each full step = ~0.25° of rotation. Made from cast & machined resin & alum. Attached slide provides 3" travel. Construction similar to slide above. Moves 0.008" per step. Dual optical end of travel sensors. Overall 7.5"L x 5.25"W x 4.5"H. **Special \$59ea or 2/\$99**

NEW MICRO CAMERA, w/audio

1/3" CCD, 410 Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Pwr. from 9 to 12VDC @100mA, 250k PIXELS, Std. model, 3.6mm, 92° FOV lens, Pinhole, 90° FOV. A real glass lens. Both focus from 10mm to infinity. Std. NTSC video out. 1/2 once! SENSITIVE to IR. Size Std: 1.25"sq. x 1" d. PH is 0.6" d. Both with 6" leads. **WARNING: Don't confuse these models with LOW RESOLUTION, HIGH LUX C-MOS CAMERAS. Six models to choose from.**

GM-1000A-STD.....\$80 GM-1000A-STD/Aud.....\$85
GM-1000A-PH.....\$80 GM-1000A-PH/Aud.....\$85
GM-1000A-CMNT..\$80 GM-1000A-CMNT/Aud..\$85

Micro Lenses for GM1000 series			
2.5mm, 150°.....	\$22	8.0mm, f2.0.....	\$22
4.3mm, 78° f1.8.....	\$22	12.0mm, f2.0.....	\$22
6.0mm, f2.0.....	\$22	5mm, 70°PH.....	\$22



LENGTHLY LINEAR SLIDE, CAN GIVE YOU A LIFT as WELL !

Four different lengths available, all with similar construction. All units based on a heavy duty 1.5" wide, stainless steel, dual rail. Drive is via a toothed belt, powered by a SLO-SYN M061-LF-504, 1.25V @3.8A stepper motor with 200 steps per rev and 60 oz. in. hold. The "Medium unit" shown right, also includes a precise Z axis drive, providing 3.5 inches of precise travel by virtue of its' 4:1 ratio toothed belt drive. Powere is by another M061-LF-504 stepper. The remaining three lengths have no Z drive. All units incorporate a superior quality, recirculating ball bearing slide with 3" x 3" x 1/2" thick mounting plate. "Z" unit size: 7"H x 2.5"W x 5.75D Very limited quantity. Also the "short" slide is mounted on a 1/4" thick anodized alum. plate. All have been carefully removed for precision optical equipment. The dimensions and travels are listed below:

Model	Travel	Rail L"	Weight	Overall Size	Price
Ex Long:	46"	49"	12lbs.	51"L x 5"W x 3.5"H	\$149ea. or \$269 for pair.
Long:	30"	33"	9lbs.	39"L x 5"W x 3.5"H	\$129ea. or \$229 for pair.
Med.w/Z:	20"	23"	12lbs.	24"L x 2"W x 4.6"H	\$139ea. or \$249 for pair.
Short:	11.5"	16"	7lbs.	16"L x 4"W x 6.5"H	\$69ea. or \$119 for pair.

PRICE BUSTER, DSP, COLOR CAMERA,

Brand New, model GM550, Size: 1.6" x 1.6" x 1.5"L, 1/3" CCD with SONY CCD & DSP technology. 4mm, f1.8 glass lens, 80° FOV. Resolution >350 lines, sensitivity, 0.3lux, AWB, AGC & auto electronic shutter 1/60 to 1/10,000 sec. Pwr. 12VDC @160ma. NTSC out. Budget color surveillance. **Reg. \$269, SPECIAL GM550-STD.....\$149ea. GM550-PH.....\$149ea.**

CHECK THIS! ULTRA MINI AND WEATHERPROOF

Our "LIPSTICK" camera sets new standards. Sleek black anodized, aluminum, housing is O-Ring sealed & RAIN-PROOF. Adjustable tilting mount included. Specs: 1/3" CCD, 380 Lines resolution, 0.3 Lux sensitivity, AGC, Auto Shutter. Operates on 9 to 12VDC @100mA, 3.7mm, 90° FOV lens. A real glass lens. NTSC video out. 1/2 once! SENSITIVE to IR. Ultra small Size only: 23mm diam. X 50mm long. With 36" cable with BNC video and DC barrel jack. **GM-200KSTD...\$99 pwr. adapter..\$4.95**

"EMBEDABLE", PINHOLE LENS, "BULLET CAM" it's INCREDIBLE !

So tiny you can install it right into a door with merely an 0.9" diameter hole. Sleek black anodized, extruded aluminum housing. Similar construction as the lipstick camera above only smaller! 1/3" CCD, 410 Lines Res., 0.3 Lux sens., AGC, Auto Shutter. Power from 9 to 16VDC @100mA, 250k PIXELS, 90° FOV Pinhole lens. A real glass lens. Std. NTSC video out. 1/2 once! SENSITIVE to IR. Size only 23mm Diam. x 35mm long. With 36" leads. Think of the places you could put this little jewel. **GM-200KPH lens....\$99**

Please fax us your list of unique surplus material.

6V @ 12 AH SEALED, RECHARGEABLE, LEAD ACID BATTERY



Brand new Panasonic type LCR6V12PI, tough to get at a discount. Very compact. Use two for a 12V @ 12AH pack. Two top mounted 1/4" faston connectors. Perfect for robotics

and other high drain applications. Size: 5.9"L x 3.7"H x 1.97"D **REG. \$18ea. NOW 2 for \$20, or 10 for \$89**

PELTIER, THERMO-ELECTRIC COOLERS with Fan and Heatsink,



Super cooler brand air to air and air to surface units. (right) Operate from VDC and provides ~20Watts of cooling or about 15deg. F differential for the air to air and about >20deg. F differential for the air to surface. The air to air unit has two brushless fans one for heat removal and one for cool

air circulation. The air to surface unit has one brushless fan for heat removal and an aluminum cold plate. The overall size of the air unit is: 4"L x 5.2"H x 2.6"W The surface unit is: 3.75"L x 3"H x 2.3"W Removed from equipment. Excellent condition. All black anodized alum. construction. **SPECIAL...AIR to AIR 59 or Air to SURFACE \$39**

COMPACT 3mW ARGON LASER. Super brilliant turquoise beam.

Looks as bright as a 20mW HeNe! New, Uniphase 2202-3 with pwr. supply. The 488nm, TEM00 mode is something to see! The power is in the wavelength. This highly visible beam operates where the eye is most sensitive. Very impressive for it's size. Head only 2.5" diam. and 13" long. Plug and play operation. Standard 110VAC operation. Compact power supply and fan cooled head. Less than 1/4 the price of a new one. Photo not available at pres time. Looks like a scaled down version of the 2213 below. **Reg. \$3000 Our price.....\$695ea.**

HIGH POWER BLOWER, from AMETEK, Model 117643-01 or 116643-02



Available in 240VAC @2.5A or 120VAC @4A operating voltage. Brushless type with isolated speed control. With a 0 to 10VDC signal applied to the control pin blower speed varies from 0 to 100%. Produces up to 120CFM. Can operate with static pressures up to 25" H₂O. Size: 5.9" diam x 5.2" w. With 1.75" O.D. output port. Specify Voltage. **Reg. \$165 NOW.....\$39ea. or 2 for \$69**



POWERFUL, DC GEARMOTOR, New, Pittman, Gm9213C152, 22 RPM @ 24VDC. 200 mA @ Full load. 1/4" Shaft. 218:1 ratio for "TONS of TORQUE" perfect for motion control. Size: 3.5"Lx2"Diam. Ltd. Qty. **PRICE.....\$12 3 for \$29**



Brand New, Video Motion Sensor. Model VM10. Attach to any standard video signal and you've got an electronic "watchman" diligently watching the entire scene. Or any adjustable sized area within the scene. Such as a doorway or even a drawer or cabinet. A state of the art security aid. The unit will close a contact when it senses a change. Use it to turn on a VCR or call the hounds. Auto or manual reset. Compact, ac powered. Adjustable sensitivity. Video loop through jack. **NEW VM-10.....\$189.**

WORLDS SMALLEST ... 100mW ...

VIDEO TRANSMITTER,

Incredibly only 0.98" x 0.8" x 0.037" in size. Transmits crystal controlled hi-res. images with 100mW output! The transmitter you've been waiting for.

Shown actual size. Much smaller than the 9V battery which powers it. Draws only 35mA! Factory tuned ready to receive on cable channel 59. Will work with color or B&W cameras. UHF Bow tie antenna with balun and 3' F cable for TV included. Perfect with our GM1000A cameras. Both will fit in a cigarette pack...with the battery! The best deal anywhere. **TVX-100...\$189. with GM1000A-PH CAM...\$259.**

YOU CAN NEVER BE TOO THIN or TOO POWERFUL.

Unique "Thinline Energy Cell from Portable Energy Products. Their model PLA02V50. A super thin, high performance, patented technology, sealed lead acid battery. Each cell provides 2V@5AH. Their size is an amazing 3.1" x 5.3" x 0.3" thick! They can be mounted in any orientation. Can line the bottom of a briefcase or be covertly worn on the body. 30% higher energy density than conventional lead acid batteries. **Price 6 cells for \$15 or 24 for \$49**



RESOURCES UN-LTD.

300 BEDFORD STREET, MANCHESTER, NH 03101

VISA, MC, AMEX, DISCOVER, COD. ORDER: 800-810-4070 TECH. 603-668-2499 ORDER FAX: 603-644-7825 E-MAIL unlt4u@tiac.net

ELECTRONIC CIRCUIT SYMBOLS & NOTATIONS

by Ray Marston

Ray Marston looks at some controversial aspects of modern circuit symbology in this special feature article.

INTRODUCTION

Back in May '97, I started writing regular 'circuit application' feature articles for *Nuts & Volts* magazine. All of these articles are specifically aimed at experienced design engineers and competent electronics enthusiasts (rather than at novices or complete beginners), and are unusual in two special respects.

They are unusual, first, because most of them carry (on average) about 20 illustrations or practical circuit diagrams, and second, because all of the circuit diagrams use International style — rather than US Customary — circuit symbols and component notations.

All of these articles have been well received by most *Nuts & Volts* fans, but some readers (who admit to being electronics novices) have complained that they are quite bemused by the component notations that I use in these articles. I suspect that quite a few other *Nuts & Volts* fans may feel the same way so, in this special article, I aim to explain the operation of the International style electronic circuit diagram system, and to explain the system's advantages over the US Customary system. This is a fairly controversial subject and may annoy some readers, so I will start off by presenting my qualifications for writing about it, as follows:

MY QUALIFICATIONS

I have been an electronics design engineer and writer/author for over 30 years. During that peri-

od, I have — amongst other things — been editor or technical editor of four different electronics magazines, have written about 2,000 technical articles, and have written 31 electronics engineering books. Many of my magazine articles are published internationally, and — in various periods — have appeared regularly in magazines in the UK, Germany, Holland, Australia, Canada and the USA.

Of my 31 books, two were first published in Germany, and the rest in the UK; several were later published in the USA. Between them, these books have been translated into about a dozen different languages (often with suitably modified circuit diagrams), including Russian, Hindustani, and most major European tongues.

Throughout the past five years, I have produced most of the artwork and circuit diagrams that accompany my books and magazine articles (including those used in *Nuts & Volts*), using a *Corel DRAW 3* artwork/CAD package and my private symbols library. I generate an average of about 350 diagrams a year, and have thus produced about 1,750 technical

illustrations and diagrams in the past five years.

As a consequence of all the above, I have lots of professional experience in the technical publishing business and in generating modern circuit diagrams, and am familiar with many of the different electronic circuit symbol and notation systems that are used in various parts of the world and with their specific advantages and disadvantages compared to other systems.

TYPICAL CIRCUIT DIAGRAMS

In the western world, most major industrial countries have their own individual preferred styles for electronic circuit symbols and notations, but these styles are not too rigidly applied and often vary considerably between one technical publisher and another, according to the 'house style' of the individual publishing company. In the USA, for example, the so-called 'US Customary' system is normally used, but the precise details of the system vary significantly between different electronics magazines.

Figures 1 to 5 show examples

of how exactly the same circuit diagram can vary when published by particular electronics magazines in particular parts of the western world. The circuit is that of a simple LM386 audio power amplifier, with its voltage gain set at x200 by C4 and with its output protected by the C3-R1 Zobel network and loaded by an eight-ohm speaker.

Figure 1 shows the diagram drawn using the familiar US Customary system, using the basic house style of *Electronics Now* magazine, and Figure 2 shows the same diagram drawn in the house style of the German electronics magazine *Elrad*, which uses a simple rectangular symbol (rather than a zig-zag) to represent a resistor.

Regarding the German capacitor symbols, the two parallel lines used to represent C1 and C3 indicate that these are ordinary non-electrolytic components, and the black and white rectangles used to represent C2 and C4 indicate that these are electrolytic capacitors; the '+' signs associated with C2 and C4 indicate that the capacitors are polarized types, and that the white terminal is positive.

In the UK, British electronics

**GETS YOU ABOVE THE REST**

US Tower is the largest and fastest selling self supporting steel tower sold in the United States. **GET ABOVE THE REST** with room to spare with heights up to 106 feet and 60 sq. feet wind load.

We promise you:

- Very personal care - we only sell the US Tower line.
- Better than competitive pricing - try us!
- We will help plan your installation.
- If this is your first tower we will hold your hand and walk you through all aspects from start to finish.
- Full "turn-key" installations available - call us!

This is our 14th year representing U.S. Tower.

If you are interested in US Tower literature or obtaining a tower price quote, call 800-HAMTOWE(R) (800-426-8693) or e-mail us. Be sure to look at our web page for a complete listing. First Call is one of four factory direct distributors in the United States. We also sell commercial self-supporting steel towers from 20 feet to 440 feet for our PCS, cellular and amateur customers. *We now ship worldwide.*

**FIRST CALL COMMUNICATIONS, INC.**
28 Grove Street, Spring Valley, New York 10977
Phone: 914-352-0286 800-HAMTOWE(R) (800-426-8693)
Fax: 914-578-6550 E-mail: firstcall@cyburban.com
Web: www.firstcallcom.net Hours 9-5 pm ET Mon.-Fri.

**WE SHIP WORLDWIDE**

MORE POWER!
68HC11, 80C51 & 80C166

AM Research supports over 30 of the most popular Embedded controllers with both **hardware** and **software**.



- ✓ More Microcontrollers
- ✓ Faster Hardware.
- ✓ Faster Software.
- ✓ More Productive.
- ✓ More Tools & Utilities.
- ✓ IIC Peripherals.
- ✓ Single Chip Capable.
- ✓ Outstanding Support.
- ✓ Custom designs.

Call or email for a free full line brochure



Orders (800) 949-8051
Info (916) 652-7472
fax (916) 652-6642
www.amresearch.com

AM Research, Inc.
PO Box 43
The Embedded Controller Experts Loomis, CA 95650

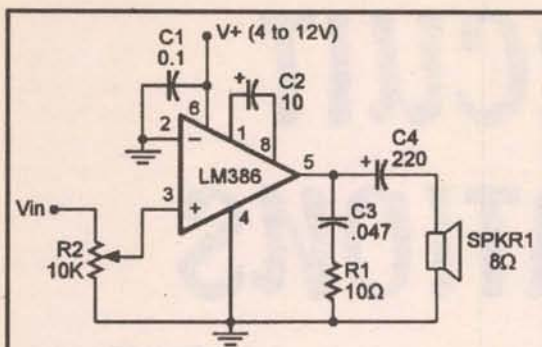


Figure 1. Circuit in the house style of *Electronics Now* magazine (USA).

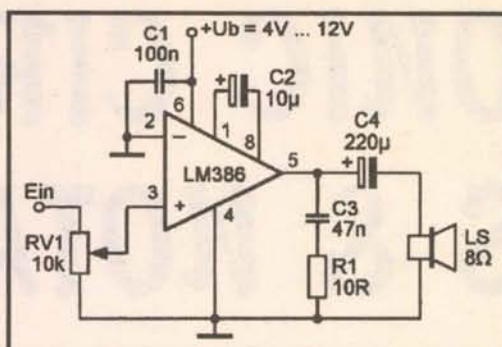


Figure 2. Circuit in the house style of *Elrad* magazine (Germany).

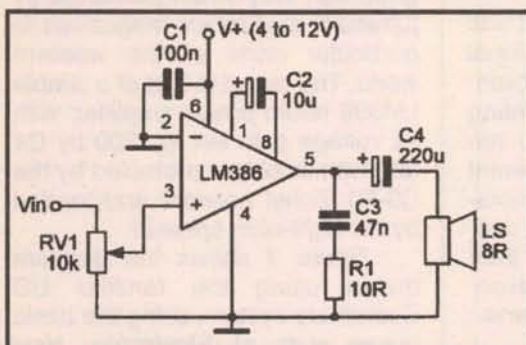


Figure 3. Circuit in the house style of *Electronics Today International* magazine (UK).

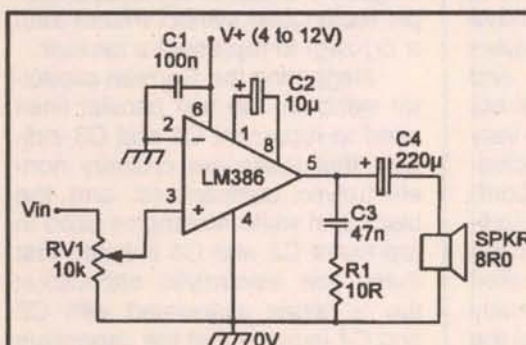


Figure 5. Circuit drawn in typical International style.

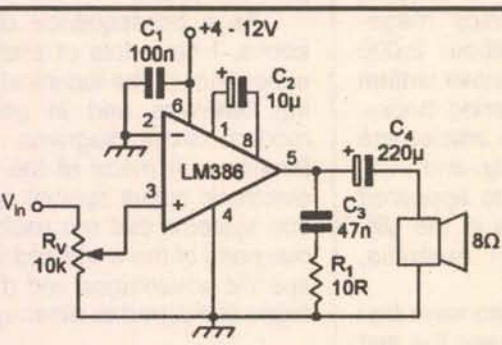


Figure 4. Circuit in the house style of *Electronics World* magazine (UK).

magazine sales are dominated by six popular titles. Half of these use the zig-zag resistor symbol in their circuit diagrams, and half use the simple rectangular symbol. Figure 3 shows the Figure 1 diagram redrawn in the house style of one of the most popular British electronics magazines, *Electronics Today International*, which uses the simple rectangle to

represent a resistor, and uses two black rectangles to represent an ordinary non-electrolytic capacitor.

The most prestigious British electronics magazine is *Electronics World*, which is aimed directly at professional engineers and managers; it has its own basic house style for circuit diagrams, but varies the style slightly from article to article. Figure 4 shows Figure 1 redrawn in this magazine's basic house style; note the awkward mixture of upper-case and subscript characters used to denote component numbers, etc.

Finally, Figure 5 shows Figure 1 drawn in my own particular version of the International circuit diagram style (which I use in my *Nuts & Volts* articles), in which resistors are drawn as zig-zags, capacitors are in simplified European style, and component values are given in formal 'International' style, which is explained in a later major section of this article.

Note in Figures 1 to 5 that all five basic diagrams are quite easy to understand, in spite of the variations in the styles of the symbols used to represent resistors, capaci-

tors, ground points, and loudspeakers. Also note that the variable resistor is notated by RV (Resistor, Variable) in the four non-US diagrams, but by a simple R in Figure 1. Finally, note that the Figure 2 to 5 diagrams use a plain R instead of the symbol to indicate a resistor's value in ohms, and (in Figures 2 and 4) use the symbol only to indicate the loudspeaker's nominal impedance value.

The easily-understood Figure 1 to 5 circuits are analog designs. Foreign digital designs can be far harder to understand. Figure 6, for example, shows some of the crazy official symbols used to represent simple logic gates in Europe. In practice, most European electronics book and magazine publishers sensibly adhere to the American MIL/ANSI symbol system, which is also used in the normal 'International' diagram system.

For most American readers, the only problems presented by the non-US Figure 2 to 5 diagrams relate to the International component value notation systems that they use, which all notate the 10 resistor as 10R, and notate 0.047μF capacitor C3 as 47n (the odd 220u — rather than 220μ — notation used on C4 in Figure 3 is simply a house style peculiarity used by one UK magazine). Before explaining how the International notation system works, I will explain why it was developed.

EVOLUTION OF THE 'INTERNATIONAL' SYSTEM

Prior to the mid 1970s, the electronic component notation systems used by most European countries were similar to the present US Customary system and were loosely based on the metric scientific notation system that — in 1960 — became officially known as SI (Système Internationale d'Unités).

In the 1960s, however, major developments in the semiconductor industry resulted in a great increase in the complexity of practical circuit designs, and industry and commerce began looking for ways of producing the resultingly complex circuit diagrams and literature with greater efficiency.

Matters reached a historic peak in 1975 when the British Standards Institute (BSI) published — after a very long period of study and consultation — a list of recommendations concerning this subject.


Many of the 1975 BSI recommendations — particularly those relating to the use of new digital circuit symbols — were pretty stupid, and were rejected by most of the electronics industry, but those relating to an international system of electronic component-value notation were excellent, and were soon adopted by most of the world's industrial nations, with the notable

PRIMECELL

IF YOU NEED NEW BATTERIES FOR YOUR ELECTRONIC EQUIPMENT
DON'T PITCH EM' - SEND THEM FOR REBUILDING! - SAVE \$ \$

CUNARD ASSOCIATES, R.D. 6 Box 104, Bedford, PA 15522

- WE INSTALL NEW NI-CAD OR NI-MH BATTERIES INTO YOUR ORIGINAL CASE.
- WE IMPROVE CAPACITY TO BETTER THAN ORIGINAL.
- WE FIX WHAT CAN'T BE FOUND. (OR AFFORDED)
- WE PROVIDE QUICK SERVICE. / EXTENDED LIFE FOR OLDER EQUIPMENT
- WE OFFER FREE QUOTES. / FREE RETURN IF QUOTE IS REFUSED.
- WE PROPERLY DISPOSE OF YOUR OLD CELLS BY RECYCLING.
- WE GIVE YOU A 12 MONTH WARRANTY.
- WE WILL BE HERE WHEN YOU NEED US / 12 YEARS IN BUSINESS.
- WE SAVE YOU **** MONEY **** \$ \$ \$ \$



GENERAL ELECTRIC

MPD/PLS - MPR/MPX/MPX
19A704850P(1200mAh) \$ 34.95
19A704860P(1800mAh) \$ 39.95
PL19D429763(777)G1/3 \$ 37.95
MAXON SA-1155 1160 \$ 39.95
TAD 1450 1510 1520 \$ 21.95

MOTOROLA

P200 HT600 MT1000
NTN 4585 4824 5414 \$ 37.95
NTN 5447 5521 5545 \$ 37.95

MIDLAND

70-B10 B16 B19 B21 \$ 39.95
70-B32 70-B36 \$ 39.95

UNIDEN

APH56 APX500 \$ 21.95
APX650 1050 \$ 29.95
1000 1100 1200 \$ 34.95
BP100/200/205 \$ 14.95
205 Inc to 1350 \$ 22.95

ICOM

BP2 / BP3 / BP22 \$ 18.95
BP5 / BP23 / 24 \$ 24.95
BP7 / CM7 / BP8 \$ 34.95

YAESU

FNB 3 4 12 14 16 \$ 32.95
FNB19 21 26 27 38 \$ 32.95
FNB 17 25 35 \$ 23.95

BENDIX KING

KR105/LAA125 \$ 34.95

KENWOOD

PB2 / KNB3 \$ 29.95
PB21/21H \$ 14.95
PB25/H26 \$ 24.95

CORDLESS DRILLS

Any brand 7.2V \$ 18.95
Any brand 9.6V \$ 29.95
Any brand 12.0V \$ 32.95
Any brand 14.4V \$ 37.95

SURVEYING EQUIP.



COMPUTERS - PHONES

Send battery for quote.

FOR INFORMATION ABOUT YOUR REQUIREMENTS CONTACT US:
PHONE OR FAX: (814) 623-7000 E-MAIL TO: PRIMECELL@AOL.COM
SEND YOUR PACKS FOR FREE QUOTATION VIA UPS, RPS OR US MAIL
DOWNLOAD OUR CATALOG, WEB SITE: <http://users.aol.com/PrimeCell>

BATTERY REBUILD SERVICE

MANY OTHERS AVAILABLE - WRITE OR CALL
FREE CATALOG
ADD \$ 4.50 SHIPPING & HANDLING PER ORDER

BIG POWER

LOW COST



Dominoes are rugged, miniature encapsulated controllers that combine lots of analog and digital I/O with a fast control-oriented floating-point BASIC to provide a one-stop computation and control solution for cost-sensitive control tasks. Used stand alone or connected via RS-232/RS-485, Dominoes are true plug-and-go control.

Domino 1 features:

- Full floating-point ROMed BASIC
- 32-KB SRAM and 32-KB EEPROM
- 12 bits of parallel I/O
- 2 PWM outputs
- I²C bus
- 2-channel 12-bit ADC
- Serial port: 19.2-kbps RS-232A, RS-422, or RS-485
- +5V @ 15 mA

Domino 2 has:

- everything in Domino 1 plus
- 16 more bits of high-current parallel I/O
- Hardware clock/calendar
- Wide-range power operation
- Hardware PWM output

\$99 to \$139

Visit our Web site for complete datasheets
www.micromint.com

To Order Call: **1-800-635-3355**
4 Park St., Vernon, CT 06066
(860) 871-6170

exception of the USA.

This new notation system was, in effect, an improved and streamlined version of the existing SI-based system, and was thus quite easy to learn. When its basic form was first specified, it was required to be designed as a simple easily-printed code that indicates an electronic component's value clearly, briefly, without ambiguity, and with a minimum loss of clarity if poorly printed.

This last requirement immediately ruled out the use of decimal points in the new code system, and the requirement for brevity called for (1) the elimination of all superfluous information from the code, and (2) for sensible compression of the remaining data.

Regarding point (1) in the 'brevity' requirement, note that in circuit diagrams, when indicating the value of a symbolic resistor, capacitor, or inductor, it is self-evident that the component's value is expressed in basic units of ohms, Farads, or Henrys, and the new code's design specification thus demanded the elimination of this superfluous 'postscript' data from the printed code *when used in circuit diagrams* (but not necessarily in normal printed text).

Regarding point (2) in the 'brevity' requirement, this was to be aided by using a fixed three-decade spacing between the decimal 'multiplier' units used to indicate a component's value.

Figure 7 lists the range of decimal multiplier units — using basic SI scientific notation and three-decade spacing — that are normally used in electronics, together with their normal prefixes, etc., and Figure 8 shows how they are applied in the modern US Customary notation system (which was also widely used in pre-1975 Europe).

Note in Figure 8 that the US Customary system uses three-decade multiplier spacing when notating values of resistance, inductance, frequency, and time, but inexplicably uses six-decade spacing (between μF and pF) when notating values of capacitance. This six-decade spacing is a major cause of the cumbersome capacitance-value notations (such as $0.001\mu\text{F}$) that often appear in US circuit diagrams.

These, then, were the basic ideas behind the creation and development of the 1975 BSI component notation system, which today is known as the 'International' system. Let's now look at the details of the modern version of this system.

Logic function	American (MIL/ANSI) Symbol	British (BS3939) Symbol	Common German Symbol	International Electrotechnical Commission (IEC) Symbol
Buffer	IN OUT	IN OUT	IN OUT	IN OUT
Inverter (NOT gate)				
2-input AND gate				
2-input NAND gate				
2-input OR gate				
2-input NOR gate				
2-input EX-OR gate				
2-input EX-NOR gate				

Figure 6. A selection of widely used logic symbols.

THE 'INTERNATIONAL' SYSTEM

RESISTANCE NOTATION

The standard unit of resistance

is the ohm, named after a Bavarian, George Simon Ohm who, in 1827, published the results of his research into electrical resistance and whose name is commemorated by the symbol Ω

(omega), which is the Greek equivalent of the Bavarian letter Ö. In 1975 (prior to the advent of the wordprocessor and CAD drawing), the symbol Ω was not carried on normal typewriters and was time-consuming to produce using normal drawing techniques.

Consequently, in 1975, the BSI recommended that the symbol Ω should no longer be used on circuit diagrams as a postscript when denoting resistance values, that *units* of resistance should be notated by the capital letter R, that *thousands* of units be notated by the lower-case letter k (for kilohm), and *millions* of units be notated by the upper-case letter M (for megohms). Thus, in this system, 47Ω , $47\text{k}\Omega$, and $47\text{M}\Omega$ become 47R, 47k, and 47M.

CAPACITANCE NOTATION

The standard unit of electrical capacitance is the Farad, represented by the symbol F. In electronics, the Farad is too large a unit for general use and, prior to 1975, most capacitors had values that were expressed in units of a millionth of a Farad (μF) or a millionth of a Farad (pF).

Thus, $1\mu\text{F}$ equals 1,000,000pF. This six-decade space between basic multiplier units obviously results in excessively long component notations, and BSI recommended that this problem be elim-

TONER CARTRIDGE RECHARGE

& Laser/Printer Supplies

CALL NOW FOR YOUR FREE CATALOG #13!

Instruction Manual
Free with starter kit

Video Training Tapes
choose from our library

Catalog #13
100 pages
FREE!

Marketing Flyers
with customized pricing

Printer/Copier/Fax Cross Reference
68 pgs-Free with any order

- Black, Color & MICR Toners
- Tools and Accessories
- Technical Support
- Cartridge Parts
- Video Training Tapes
- OPC Drums and Belts
- InkJet Refill Supplies
- Graphic Black Toner Kits
- MICR Toner Kits

Visit our website at www.chenesko.com

for all the free tech documents, Sales Specials and the latest industry news!

CP CHENESKO PRODUCTS

Chenesko Products Inc.
2221 Fifth Ave., Suite 4,
Ranikonnema, NY 11779
Fax: 516-467-3223
E-Mail: chenesko@out.com
<http://www.chenesko.com>

800-221-3516

World Passing You By?

Are you interested in Microprocessors & Embedded Control Systems? If not you should be! Look around, just about everything these days has an embedded microprocessor in it. TVs, cars, radios, traffic lights & even toys have embedded computers controlling their actions. The Primer Trainer is the tool that can not only teach you how these devices operate but give you the opportunity to program these types of systems yourself. Examples & exercises in the Self Instruction manual take you from writing simple programs to controlling motors. Start out in Machine language, then move on to Assembler, & then continue on with optional C, Basic, or Forth Compilers. So don't be left behind; this is information you need to know!

Examples Include:

- Measuring Temperature
- Using a Photocell to Detect Light Levels
- Making a Waveform Generator
- Constructing a Capacitance Meter
- Motor Speed Control Using Back EMF
- Interfacing and Controlling Stepper Motors
- Scanning Keypads and Writing to LCD/LED Displays
- Bus Interfacing an 8255 PPI
- Using the Primer as an EPROM Programmer
- DTMF Autodialer & Remote Controller (New!)

The PRIMER is only \$119.95 in kit form. The PRIMER Assembled & Tested is \$169.95. This trainer can be used stand alone via the keypad and display or connected to a PC with the optional upgrade (\$49.95). The Upgrade includes: an RS232 serial port & cable, 32K of battery backed RAM, & Assembler/Terminal software. Please add \$5.00 for shipping within the U.S. Picture shown with upgrade option and optional heavy-duty keypad (\$29.95) installed. Satisfaction guaranteed.

EMAC, inc.

11 EMAC WAY, CARBONDALE, IL 62901
618-529-4525 Fax 457-0110 BBS 529-5708
World Wide Web: <http://www.emacinc.com>

1985 - 1998
OVER 12 YEARS OF SERVICE

Prefix	Symbol	Multiplier
giga	G	10 ⁹
mega	M	10 ⁶
kilo	k	10 ³
(unit)	(unit)	10 ⁰
milli	m	10 ⁻³
micro	μ	10 ⁻⁶
nano	n	10 ⁻⁹
pico	p	10 ⁻¹²

Figure 7. Decimal multiplier scientific notations.

Multiplier	R	C	L	f	Time (seconds)
10 ⁹	—	—	—	G	—
10 ⁶	M	—	—	M	—
10 ³	k	—	—	k	—
10 ⁰	Ω	F	H	Hz	s
10 ⁻³	m	—	m	—	m
10 ⁻⁶	—	μ	μ	—	μ
10 ⁻⁹	—	—	—	—	n
10 ⁻¹²	—	p	—	—	p

Figure 8. Multiplier symbols used in the US Customary notation system.

Multiplier	R	C	L	f	Time (seconds)
10 ⁹	—	—	—	G	—
10 ⁶	M	—	—	M	—
10 ³	k	—	—	k	—
10 ⁰	R	F	H	Hz	s
10 ⁻³	m	—	m	—	m
10 ⁻⁶	—	μ	μ	—	μ
10 ⁻⁹	—	n	—	—	n
10 ⁻¹²	—	p	—	—	p

Figure 9. Multiplier symbols used in the International notation system.

inated by reducing the spacing between multiplier units to three decades, by introducing a unit known as the nanofarad (fully notated as nF), and equal to 1000pF. Thus, 1nF equals 0.001μF, and 1000nF equals 1μF.

In circuit diagrams, when indicating the value of a capacitor, it is self-evident that the component's value is expressed in Farads, and it is thus superfluous to re-state the fact in the diagram.

Consequently, the BSI recommended that, for component notation purposes, the symbol F should no longer be used on circuit diagrams as a postscript

when denoting capacitance values, and that the scientific symbols μ, n, and p be used as basic multiplier

units. Thus, in this system, 4,700μF, 47μF, 0.047μF, and 47pF become 4,700μ, 47μ, 47n, and 47p.

Component number	U.S. Customary	International style
C1	22pF	22p
C2	0.001μF	1n0
C3	0.01μF	10n
C4	0.047μF	47n
C5	.1μF	100n
C6	1μF	1μ0
C7	470μF	470μ
R1	8 Ω	8R0
R2	220Ω	220R
R3	1.2kΩ	1k2
R4	4.7k	4k7
R5	100k	100k

100% scale

Component number	U.S. Customary	International style
C1	22pF	22p
C2	0.001μF	1n0
C3	0.01μF	10n
C4	0.047μF	47n
C5	.1μF	100n
C6	1μF	1μ0
C7	470μF	470μ
R1	8 Ω	8R0
R2	220Ω	220R
R3	1.2kΩ	1k2
R4	4.7k	4k7
R5	100k	100k

77% scale

Component number	U.S. Customary	International style
C1	22pF	22p
C2	0.001μF	1n0
C3	0.01μF	10n
C4	0.047μF	47n
C5	.1μF	100n
C6	1μF	1μ0
C7	470μF	470μ
R1	8 Ω	8R0
R2	220Ω	220R
R3	1.2kΩ	1k2
R4	4.7k	4k7
R5	100k	100k

66% scale

Component number	U.S. Customary	International style
C1	22pF	22p
C2	0.001μF	1n0
C3	0.01μF	10n
C4	0.047μF	47n
C5	.1μF	100n
C6	1μF	1μ0
C7	470μF	470μ
R1	8 Ω	8R0
R2	220Ω	220R
R3	1.2kΩ	1k2
R4	4.7k	4k7
R5	100k	100k

50% scale

Figure 10. A selection of US Customary notations and their International system equivalents, reproduced at 100%, 77%, 66%, and 50% scales.

INDUCTANCE NOTATION

The standard unit of electrical inductance is the Henry, represented by the symbol H. In circuit diagrams, when indicating the value of an inductor, it is self-evident that the component's value is expressed in Henrys, and it is thus superfluous to re-state the fact in the diagram. Consequently, in 1975, the BSI recommended that — on circuit diagrams — the capital letter H should only be used to notate actual units of inductance, that thousandths of units be notated by the lower-case letter m (= millihenry), and millionths of units be notated by the symbol μ (= microhenry). Thus, in this system, 47H, 47mH, and 47μH become 47H, 47m, and 47μ.

DECIMAL POINTS

Decimal points sometimes become so severely degraded during the printing process that they cease to have a final practical value. As an example of this process, take the case of the decimal point associated with C1 in Figure 1. I originally generated this diagram in Corel DRAW vector format, with the C1 notations set in Arial text at 10-point size, under which conditions the decimal point takes the form of a 0.3mm x 0.3mm square.

To prepare this vector diagram for minimum-cost publishing, I then converted the drawing to Tiff 5.0 bitmap format at 300 dpi (in which the decimal point measures 4 x 4 pixels), and then scaled the bitmap to the '77%' of original' size at which it is meant to be printed in *Nuts & Volts* (at which scale the point size reduces to 3 x 3 pixels). The complete bitmap was then printed out on high quality paper using a Laserjet printer and mailed off to *Nuts & Volts*.

On receipt of my artwork, *Nuts & Volts* scanned my bitmap into the magazine's printer, which then transferred the diagram to the printed page, where the decimal point probably measures 2 x 2 pixels, i.e., its size has fallen from 16 pixels to 4 pixels in the production process.

Thus, this minimum-cost artwork production process results in severe loss of the decimal point's definition. This problem can be reduced, at a much increased cost, by supplying the publisher with a disk copy of the full-scale Tiff 5.0 bitmap, which can then be fed — at an appropriate scale — directly into the publisher's printer, but even this process results in a final decimal point size of no more than 9 pixels at 77% scale.

The important thing to note from the above is that decimal points often become severely degraded during the printing

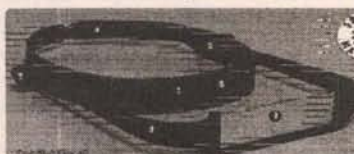


CHIPQUIK - The NEW PATENTED SMD REMOVAL KIT. Simply by adding CHIPQUIK, normal solder will reflow at a safe low temperature below 150 deg. C (300 deg. F). >Eliminate heat damaged pads, leads, and circuitry. >Eliminate thermal blisters, burns, and board delamination. >Save the cost of lost time and the cost of lost labor. >Save the cost of boards lost from heat damage.

Unlimited shelf life and can be used with existing rework equipment or temp. controlled soldering iron. Kit contains alloy, flux & syringe. Order #SMD1 \$21.50 + Shipping

SPARKY MAG-EYES Personal Magnifier

A Featherweight (1.75 oz.) personal magnifier that can be worn for hours in comfort. Reduce eyestrain and evaluate surface features quickly and easily. The lens swings out of the way and can be worn with eyeglasses. The cushioned headband is fully adjustable and can be worn with short or long hair. Supplied with 2 optical quality interchangeable acrylic lenses, 2.5x and 4x. Wide field 3D vision. Order #383 \$27.50 + Shipping

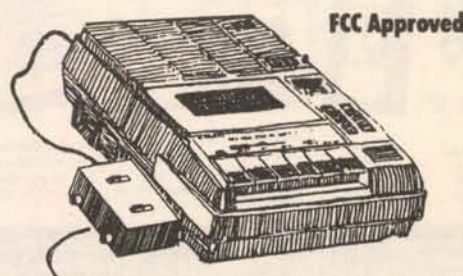


Order 3 or more items and deduct 15% off total order. Shipping & Handling is \$5.00 for 1st item; \$1.50 each additional item. MC, Visa, Discover money orders, & personal checks. Allow 3 weeks for delivery; extra week for checks.

Wayside Equip. Corp.
25 Nicholas Road
Framingham, MA 01701

Toll free: 1-877-876-6655
Fax: 1-508-788-0328
Internet: www.wec-sales.com
Email: sales@wec-sales.com

TELEPHONE LISTENING DEVICE WITH 12 HR. RECORDER



Record telephone conversations in your office or home. Starts automatically when phone is answered, records both sides of phone conversation. Recorder stops when phone is hung up. \$99.95 + \$7 shipping. For telephone listening device separately \$19.95 + \$2 ship.

For comprehensive 50 page catalog of Micro Video, VHF transmitters, Surveillance, and Counter-surveillance and much more! Send \$3.00

Call 407-725-1000

USI CORP
P.O. Box N2052 Melbourne, FL 32902
COD'S OK

process and, in their 1975 report, the BSI recommended that, for component/parameter value notation purposes, the decimal point should no longer be used and should be replaced by the basic component/parameter multiplier symbol (such as V, k, n, μ , etc.) applicable to that value. Thus, in this system, values such as 4.7V, 4.7k Ω , and 4700pF (= 0.0047 μ F or 4.7nF) become 4V7, 4k7, and 4n7.

AN OVERVIEW

There are four major differences between the International and US Customary notation systems, and two of these are illustrated in Figure 9, which shows the multiplier symbols that are used in the International system; compare this diagram with that of Figure 8, and note that the International system uses the symbol R to indicate basic resistance units, and uses the symbol n to indicate 'thousandths of a μ F' capacitance units.

Of the remaining two differences, one is that — in circuit diagrams — the International system does not use basic component 'type' symbols (such as Ω , F, or L) as component postscript notations, and the other is that the International system used the component's multiplier symbol in place of a decimal point in the actual component-value notation.

SPECIAL NOTES

Note that, although the BSI 'International' style of parameter-value notation was originally developed in the days when text was typewritten and circuit diagrams were hand-drawn, it still has great validity today, when text is generated on a wordprocessor and drawings are generated via a CAD package.

The US Customary notation '0.0047 μ F,' for example, looks clumsy, takes up lots of valuable text or drawing space, and takes 10 keystrokes to produce; the equivalent '4n7' International notation is, on the other hand, crystal clear, takes up a minimum of space, and takes only three key-

strokes to produce.

Most real-life International component notation codes consist of two or more digits plus one symbolic 'multiplier' notation; thus, in Figure 5, resistance values of 10k and 10R and capacitance values of 100n, 10 μ , and 220 μ are used. When below-unity values such as 0.1 or 0.5 μ H occur, they are notated 0R1 or 0 μ 5 in the International system. Note that the use of a two-digit code loosely implies a two-digit degree of component precision; thus, if an 8 Ω resistor is to be used in a semi-precision application, its value should be notated 8R0, but if it is only a very approximate value (such as a speaker impedance value), it can legitimately be simply notated as 8R.

The most important real-life tests regarding 'International' versus 'US Customary' component value notation systems are those relating to ease-of-use and final appearance on the printed page. You can only pass a fair comment on the first of these tests by making a genuine effort to get used to the International system, which is used by most engineers and electronics hobbyists throughout Europe and much of the rest of the world.

Regarding the second test, you can make a quick decision on this with the help of Figure 10, which shows a matching selection of International and US Customary component notations reproduced in extra-high-quality at 100% scale (full size), at 77% scale (the normal Nuts & Volts size), at 66% scale (the normal paperback handbook size), and at 50% scale (the normal small pocketbook size). Note the way in which the decimal points degrade in the smaller-scale US Customary notations.

I think the International notation system is the best of the two, and to help novice readers get used to it, future articles will, when appropriate, carry a small 'Beginner's Guide' box, giving a concise explanation of the International notation system (see Figure 11). If lots of readers continue to have problems, I will revert to the US Customary notation system in a future series. NV

Beginner's Guide to Component Notations

In this article, the values of resistors and capacitors, etc., are notated in International — rather than US Customary — style.

In resistance notation, the symbol R represents units of resistance, k represents thousands of units, and M represents millions of units. Thus, 10R = 10 Ω , 47k = 47k Ω , 47M = 47M Ω .

In capacitance notation, the symbols μ , n (= 1000pF), and p are used as basic multiplier units. Thus, 47 μ = 47 μ F, 47n = 0.047 μ F, 10n = 0.01 μ F, and 47p = 47pF.

In the International notation system, decimal points are not used in notations and are replaced by the multiplier symbol (such as V, k, n μ , etc.) applicable to the individual component value. Thus, 4V7 = 4.7V, 4k7 = 4.7k Ω , 4n7 = 4.7nF, and 1n0 = 1.0n.

Figure 11. 'Beginner's Guide' box, giving a concise explanation of the International notation system.

Credit Card FINANCING

2 Easy Payments of
\$29!
97 Edition

2 Payments of
\$29!
back issue. Perfect for Service & Experimenter

\$195
Publisher

IC MASTER
97 ICM CD
2 Easy Payments of
\$75!!

\$115
Publisher

\$235
Publisher

2 Easy Payments Any Product

Complete Catalogs of ALL Major Component Manufacturers

2 payments of
\$29

97 EEM CD

2 payments of
\$44

98 EEM CD

2 payments of
\$75

97 ICM CD
for Moderate Design Work

2 payments of
\$65

97 ICM Books

2 payment of
\$52

96 ICM Books
for Service or Lite Design

2 payments of
\$99

98 ICM CD
for Advanced Design Work

Save Time with "REFeree"

#1 Choice of Service Centers

CROSS REFERENCE & SPEC

Quarter Million Transistors, ICs & Diodes

A Specialist in "Hard to Cross House Numbers"

Easy, Powerful & Fast.

The Most Comprehensive Software Sold.

A selection yields Device Specifications & 75 to 250 Potential Replacements!

Replacement Numbers are Totally Global including Domestic, Asian, European, House Branded, as well as ECG, NTE, SK & GE. Displays Case Drawings, Lead Configuration & Pin-outs for many Devices. Coverage of Replacement Numbers is Very Impressive. 7 Disk Set (17 Meg decompressed) For DOS, Win3.1 & 95 Latest Version 7.11 Includes Many Helpful Conversion Utilities, Tables & Formulas.

Includes: 4 HUGE Consumer Electronics Industry Directories

1- Consumer Electronics Parts Sources (Service) 2- Consumer Electronics Manufacturers

3- The Entire Computer Industry 4- Semiconductor Manufacturers

Perfect for Service, Engineering and Purchasing.

Shop the way the Pro's do, Use Their Tools!

These are the books that find the "Gold". For many years they've been used by the Sharpest Purchasing Agents. Look under every rock... they're impossible to find at ANY price, let alone a great deal like this. Find: Distributors, Manufacturers and Service providers for Products, Services or ANY Component Parts imaginable. Sources for Everything from Gears to Semiconductors to Foreign Assembly Services.

2 Easy Payments of
49!

Single payment of
\$25

Parts Sources Library

Best Kept Secrets

Complete Library

Huge

WOW 2 easy payments of
\$282!
0% Financing!
On Credit Cards only

the Perfect Gift
Only a few left!

2 Payments of
\$282 Compaq 486 DX4-100
16m-710m-10.4"ds-W95-PCMCIA

2 Payments of
\$379 Compaq Pentium 90
16m-810m-9.4"Active-PCMCIA

may differ slightly from illustration

All Cards & COD Int'l orders email: netcomd@aol.com FAX 516-826-7776
Netcom 800-733-3733 ext 6300 516-826-1808 10-9 EST 7Days

Pacific Test Equipment



PACIFIC
TEST EQUIPMENT

BLOWOUT SALE

	HP 8657A Synthesized Signal Generator 0.1 - 1040 MHz with 10 Hz Resolution, +12 to -143.5 dBm 50W Reverse power protection, internal AM/FM Modulation Note: RF Connectors on rear panel (opt. 002)	Retail \$9,995 Regular \$5,900 Sale \$2,375
	HP 8656B Synthesized Signal Generator 0.1 - 990 MHz with 10 Hz Resolution, +13 to -127 dBm 25W Reverse power protection, internal AM/FM Modulation Note: RF Connectors on rear panel (opt. 002)	Retail \$7,900 Regular \$4,250 Sale \$1,875
	HP 8656A Synthesized Signal Generator	Sale \$1,050
	HP 5334B Universal Counter 0 to 100MHz, 9 digit per second resolution, rise/fall time, pulse-width, ac/dc voltage measurement. Frequency, period, ratio and time interval. Front and rear inputs in parallel. HP-IB	Retail \$2,305 Regular \$1,000 Sale \$195
	HP 3457A Digital Multimeter 3-1/2 to 6-1/2 Digit with extended resolution to 7-1/2 digits. dcV, acV, dcI, acI, Ohms, frequency and period. 1350 readings/sec. at 3-1/2 digits. HP-IB	Retail \$3,260 Regular \$2,495 Sale \$1,380
	Tektronix 2445A 150MHz Oscilloscope Auto-setup, 4 channel, 1M and 50 Ohm input impedance, dual time base, CRT readout with cursors. 2mV sensitivity.	Regular \$3,200 Sale \$1,895

Above items come with a 90 Day warranty, standard accessories, and FREE UPS Ground shipping within the continental U.S.

We accept VISA, MC and prepayment in advance. Sorry no C.O.D.'s. Quantities are limited to stock on-hand. 20% restocking fee on returns.

We Buy Late Model Test and Measurement Equipment
by HP, Tektronix, Fluke, R&S, Wavetek, Anritsu, and others.

(408) 441-7341 or fax (408) 441-8049

We also carry Brand New Iwatsu/LeCroy - Topward - LG Precision

Iwatsu/LeCroy LA314/SS-7840 400 MHz, 4 Channel Cursor, High-Speed Auto Setup, TV Trigger \$7,200	Topward Single Output <table><tr><td>Model</td><td>Meter</td><td>Output</td><td>Price</td></tr><tr><td>3603D</td><td>Digital</td><td>60V/3A</td><td>\$495</td></tr></table> Triple Output <table><tr><td>Model</td><td>Meter</td><td>Output</td><td>Price</td></tr><tr><td>6603D</td><td>Digital</td><td>60V/3A X 2</td><td>\$875</td></tr><tr><td></td><td></td><td>5V/5A Fixed</td><td></td></tr></table> <i>Others Available - Call</i>	Model	Meter	Output	Price	3603D	Digital	60V/3A	\$495	Model	Meter	Output	Price	6603D	Digital	60V/3A X 2	\$875			5V/5A Fixed		LG Precision OS-5100RB 100 MHz, 4 Channel Cursor, Auto Setup CRT Readout \$1,595
Model	Meter	Output	Price																			
3603D	Digital	60V/3A	\$495																			
Model	Meter	Output	Price																			
6603D	Digital	60V/3A X 2	\$875																			
		5V/5A Fixed																				



PACIFIC
TEST EQUIPMENT

Pacific Test Equipment Corp.

1450 Koll Cir. #111 • San Jose, CA 95112
(408) 441-7341 • Fax (408) 441-8049

For a free catalogue
or inquires on other equipment call
(408) 441-7341 M-F 9-6 (PST)
Ask for Erwin Talavera

Don Lancaster's

RESOURCE BIN

number eighty three

Fun with some neat stuff.

Our usual reminder here that the *Resource Bin* is now a two-way column. You can get tech help, consultant referrals, and off-the-wall networking on nearly any electronic, *tinaja* questing, personal publishing, money machine, or computer topic by calling me at (520) 428-4073 weekdays 8-5 Mountain Standard Time.

There's sure a lot of neat electronics and related high-tech toys which are coming out lately. Both new and as surplus bargains. So, I guess we are overdue for a review of a lot of odds and ends that you just might decide are interesting or useful ...

Build Your Own Microprocessor!

Programmable gate arrays are now large enough and cheap enough that you can use them to create your own microprocessor, ending up having the power of, say, a 6502 or a Z-80.

Besides being a superb teaching or learning experience, your own micro lets you run your things your ways. Using any mix of conventional, RISC, or DSP tricks you select. There's also those sole source and security factors. Others are not likely to guess exactly what you've got inside the box.

Typical FPGAs of interest include the *Xilinx XC4005L*. A new firm going by the name of *Space-Time Productions* now has new hardware and software support systems which literally can let you design your own micro.

These are also distributed by *Ultra Technology* whose lines do include a variety of *Forth*-based products.

PSD Optical Rangefinding

There is great interest these days in sensing distances. Traditional optical rangefinders using *parallax* methods all had a serious flaw. In that moving parts were always involved. But it is possible to "inside out" the *parallax* method and make an all solid-state optical rangefinder. The trick

is to use a special beastie called an infrared *Position Sensitive Detector*.

A pair of side-by-side plain old light sensors can even be used. You illuminate what you are measuring by using a laser or an infrared LED. You then arrange your optics so that your image moves across the sensor pair as the distance changes. The ratio of left to right output is trig related to your distance to the target.

NEXT MONTH: Don looks at some possibilities in the medical electronics area.

There is one insider trick: To make the range signals independent of color and brightness, you'll *normalize* them by calculating $(A-B)/(A+B)$. Leaving you with a *differential* output which is proportional to range only. Yeah, that division gets tricky to do analog, but is not that big a deal digitally.

Position sensitive detectors are sold by *Sharp*, *Hamamatsu*, and *Ricoh*. The *Sharp GP2D02* is a good starting point. This chip is both low-cost and micro-friendly. Several of the intended apps include camera autofocus, car "too close" alarms in garages, and even for use in restroom hand drivers. More details and bunches of further optical rangefinding resources appear in www.tinaja.com/glib/muse131.pdf. More theory about optical and PSD rangefinding in general can be found in various SPIE publications.

Find That \$#@%# Cat!

The *Catfinder* is an interesting new take on mid-distance remote controls. There is a small hand-held transmitter and up to four light weight remotes. You place one on your cat's collar to keep tabs on tabby. Press the button and the cat meows.

Well, beeps actually.

Another intended use is for people who always lose things. You attach a receiver to, say, your

VCR remote or your pager or whatever. When it gets inevitably misplaced, you find your *Catfinder* and then use it to find the remote. The claimed range is 50 to 80 feet, or the better part of half an acre. My own tests showed useful ranges, but were unable to reach their specified distances.

Cost is \$29.00 for a transmitter and one remote. And \$15.00 for extra remotes.

Your remotes get programmed to a selected channel by transmitting that channel while you install its coin cell battery. Programming is verified by a distinct double beep. The reasonably waterproof remotes are also optionally offered as contact closures rather than beepers. Leading to all sorts of remote controls.

Luminance Probes

When you measure light, you may want to sense *brightness*, finding out exactly how much light you have. But other measurement times, you might be more interested in how bright the light *appears* to a human observer. In this case, you'll be more interested in measuring *luminance*.

These two can be wildly different, because the human eye varies in its response to different colors. Your eye sees green strongest, red moderately, but blue only rather weakly.

Typical silicon photocells are very strong in the infrared but wimpy in the blue. To measure luminance, you have to carefully collect the light from the precise area you want to measure. Then you'll have to carefully filter the light to exactly match the response of the photodetector. A calibration curve is a must. Finally, you'll measure the amplitude transformed light and then convert its value to digits.

Luminance measurement is used in everything from architectural lighting to color video monitor balancing to getting colors to print out properly as grays. Your classic luminance probe has been that pricey *Tektronix J6523*. These have recently become available surplus in "almost new" condition at sane prices. These are narrow beam devices that include viewfinding and focusing. They work everywhere from 18 inches to infinity as is. By adding standard photo close-up lenses, tiny or nearby dots can be resolved.

They are intended to work with the old Tek J-16 digital photometer, but should be fairly easy to interface into nearly any DVM lashup or PC-based data acquisition system.

new from
DON LANCASTER

ACTIVE FILTER COOKBOOK

The sixteenth (!) printing of Don's bible on analog op-amp lowpass, bandpass, and highpass active filters. De-mystified instant designs. **\$28.50**

CMOS AND TTL COOKBOOKS

Millions of copies in print worldwide. THE two books for digital integrated circuit fundamentals. About as hands-on as you can get. **\$28.50 each.**

RESEARCH INFOPACKS

Don's instant cash-and-carry flat rate consulting service. Ask any reasonable technical question for a detailed analysis and complete report. See www.tinaja.com/info01 for specifics. **\$75.00**

INCREDIBLE SECRET MONEY MACHINE II

Updated 2nd edition of Don's classic on setting up your own technical or craft venture. **\$18.50**

LANCASTER CLASSICS LIBRARY

Don's best early stuff at a bargain price. Includes the CMOS Cookbook, The TTL Cookbook, Active Filter Cookbook, PostScript video, Case Against Patents, Incredible Secret Money Machine II, and Hardware Hacker II reprints. **\$119.50**

LOTS OF OTHER GOODIES

Tech Musings V or VI	\$24.50
Ask the Guru I or II or III	\$24.50
Hardware Hacker II, III or IV	\$24.50
Micro Cookbook I	\$19.50
PostScript Beginner Stuff	\$29.50
PostScript Show and Tell	\$29.50
Intro to PostScript Video	\$29.50
PostScript Reference II	\$34.50
PostScript Tutorial/Cookbook	\$22.50
PostScript by Example	\$32.50
Understanding PS Programming	\$29.50
PostScript: A Visual Approach	\$22.50
PostScript Program Design	\$24.50
Thinking in PostScript	\$22.50
LaserWriter Reference	\$19.50
Type 1 Font Format	\$16.50
Acrobat Reference	\$24.50
Whole works (all PostScript)	\$380.00
Technical Insider Secrets	FREE

BOOK-ON-DEMAND PUB KIT

Ongoing details on Book-on-demand publishing, a new method of producing books only when and as ordered. Reprints, sources, samples. **\$39.50**

THE CASE AGAINST PATENTS

For most individuals, patents are virtually certain to result in a net loss of sanity, energy, time, and money. This reprint set shows you Don's tested and proven real-world alternatives. **\$28.50**

BLATANT OPPORTUNIST I

The reprints from all Don's Midnight Engineering columns. Includes a broad range of real world, proven coverage on small scale technical startup ventures. Stuff you can use right now. **\$24.50**

RESOURCE BIN I

A complete collection of all Don's Nuts & Volts columns to date, including a new index and his master names and numbers list. **\$24.50**

FREE SAMPLES

Check Don's Guru's Lair at <http://www.tinaja.com> for interactive catalogs and online samples of Don's unique products. Searchable reprints and reference resources, too. Tech help, hot links to cool sites, consultants. email: don@tinaja.com

FREE US VOICE HELPLINE

VISA/MC

SYNERGETICS

Box 809-NV
Thatcher, AZ 85552
(520) 428-4073

Class D Amplifiers

There's been many decades of false starts, but it finally looks like Class D amplifiers are here to stay. A Class D amplifier is basically a pulse width modulator that drives a high-power switch. Your switch is followed by a potent low-pass filter to recover your PPM audio. Advantages of class D are quite low standby current, ultra high efficiency, and the ability to use low voltages. Laptop computer stereo is an obvious new application.

RESOURCE BIN

SOURCES FOR UNUSUAL NEW CHIPS AND DEVICES

Analog Devices
PO Box 9106
Norwood MA 02062
(617) 329-4700

Apex Microtechnology
5980 N Shannon Rd
Tucson AZ 85741
(520) 690-8600

Aremco
PO Box 429
Ossining NY 10562
(914) 762-0685

Hamamatsu
360 Foothill Rd
Bridgewater NJ 08807
(201) 231-0960

Harris Semiconductor
Box 883
Melbourne FL 32902
(407) 724-7000

Hewlett-Packard
PO Box 10301
Palo Alto CA 94303
(415) 857-1501

Kepro Circuit Systems
630 Axminster Dr
Fenton MO 63026
(800) 325-3878

Lindberg
304 Hart St
Watertown WI 53094
(800) 873-4468

Linfinity Micro
11861 Western Ave
Garden Grove CA 92841
(800) LMI-7011

Maxim
120 San Gabriel Dr
Sunnyvale CA 94086
(800) 998-8800

Medianix Semi
100 View St Ste 101
Mountain View CA 94041
(415) 960-7081

Micro Linear
2092 Concourse Dr
San Jose CA 95131
(408) 433-5200

MX-Com Inc
4800 Bethania Station Rd
Winston-Salem NC 27105
(800) 638-5577

National Semiconductor
2900 Semiconductor Rd
Santa Clara CA 95052
(800) 272-9959

Qualcomm/VLSI
10555 Sorrento Valley Rd
San Diego CA 92121
(619) 597-5005

Ricoh
3001 Orchard Parkway
San Jose CA 95134
(800) 957-3436

Sharp
Sharp Plaza
Mahwah NJ 07430
(201) 529-8757

Space-Time Productions
219 N Vale Ave
Rockford IL 61107
msimon@telbbs.com

SPIE
PO Box 10
Bellingham WA 98227
(206) 676-3290

Synergetics
Box 809
Thatcher AZ 85552
(520) 428-4073

Tektronix
PO Box 500
Beaverton OR 97077
(800) 835-9433

Texas Instruments
PO Box 655303
Dallas TX 75265
(800) 336-5236

Tripath Technology
3900 Freedom Circle #200
Santa Clara CA 95054
(408) 567-3000

Ultra Technology
2512 10th Street
Berkeley CA 94710
(510) 838-2149

Xilinx
2100 Logic Dr
San Jose CA 95124
(800) 244-7778

The **Texas Instruments** TPA005D02 is a good starting point. This \$3.48 chip provides two watts output from a five-volt supply with under half a percent distortion. Other sources are **Harris**, **Apex**, **Linfinity**, and **Tripath**.

For a historical perspective on Class D, see my *Electronics World* story for February of 1966. A current listing of Class D amplifier resources appears in my MUSE128.PDF.

Load Banks

A *load bank* is simply a giant toaster. Several loaves at a time, even. These get used for resistive (or sometimes reactive) loads to test generators or windmills. And for industrial process heat. Or in student power labs. Or for alternate energy research.

Load banks come in several sizes. Um, it seems I picked up one that was a tad larger than I expected. Driving home why it *really* is a good idea to look at mil surplus before you bid on it. At

any rate, this one is rated at 60 kilowatts and handles DC, normal AC, and three phase AC. This dude is available at three cents on the dollar. Terms like "sturdy" and "adequate" come to mind. Yes, it has wheels. Sort of. FOB Thatcher. Truck or trailer available. Lots more on load banks at www.tinaja.com/bargte01.html.

Whenever the Chips Are Down

There are great heaping bunches of new integrated circuits coming down the pike. Here's a few candidates that I find rather interesting ...

Analog Devices ADXL05 — A member of their new nanotech accelerometer family, useful for everything from measuring the earth's magnetic field to robot nav to air bags to premium microphones. Prices on these have finally dropped to reasonable. Free samples are sometimes offered.

Medianix MED25101 —

Digital Karaoke Audio Processor. Huh? Apparently it strips vocals from existing recordings so you can sing along with them. This is really a 16-bit digital signal processor in drag. Includes a seven band graphic equalizer and soundfield simulation.

Maxim MAX4173 — One of their high side current sensors. Used to monitor battery or circuit current values and directions. Some do provide internal sensing resistors; others are externally controllable. The high side connection preserves system grounds.

Micro Linear ML4421 — It's a variable speed AC induction motor controller. The problem with speed control on a plain old AC motor is that you have to hold both amplitude and frequency in step with each other to keep the mag flux in bounds. Feedback sensing is also tricky. This chip seems to solve both problems quite well.

Analog Devices AD9830 — This digital sinewave generator is also known as a DDS direct digital

synthesizer. You'll input a 16-bit digital word and get an analog sinewave back whose frequency is exactly controllable from near zero to around a third of its 50-MHz clock frequency. Uses the phase addition method where a selected value gets added to the ongoing result and sent to a sine lookup table.

Texas Instruments TSL235

— A single chip light-to-frequency converter has a silicon photodiode and a current to frequency converter inside a single low-cost chip. Useful for measuring light intensity. Response is strongest in the red and infrared.

MX-COM MX805A

— Unique Subaudio Signalling Processor lets you combine voice with very low-frequency digital commands. Based on CTCSS squelch tones. This little known outfit has all kinds of interesting and oddball chips for voice communication. Everything from cordless telephone scramblers to tone controllers.

National LM1971

— National, of course, has all sorts of unique low-cost and high-performance audio devices. This one is a digital audio attenuator, otherwise known as an electronic volume control. It works directly in decibels, and gives a 62 dB control range over a 115 dB dynamic range. Mute is also available.

Analog Devices SSM2163

— This new chip in their ongoing *Solid State Music* line is a complete high-performance audio mixer. The eight input channels can be sent in any combination to a pair of stereo outputs. Provides 63 dB attenuation in one dB steps. For multimedia, hi-fi, broadcast, paging, or musical instruments.

Qualcomm Q2220

— A second direct digital synthesizer for communication and audio uses. Qualcomm seems the leader in advanced digital radio and communications chips. They're also big in trellis encoders and similar low bit error rate devices.

More info on these can be found at www.questlink.com or else by viewing their respective web sites.

Some Other Toys

Here is some other stuff I've been recently playing with. Although once outrageously expensive, much of this is newly available as reasonable cost military surplus. Most of these have all sorts of "take it apart and make something new out of it" potential ...

Plotters — The older **Hewlett-Packard** pen plotters were once ridiculously expensive in larger

WE'LL MEET OR BEAT ANY COMPETITOR'S PRICE!

ALL PRODUCTS
1 Year Warranty



BRAND NEW
Wavemaster 99 Channel

• Sleep Timer • Std./HRC Switch • Parental Control

AS LOW AS \$45⁰⁰ COMPLETE
CHECK US OUT!



Formerly JES, Inc.

BEST PRICES!

FAST SERVICE

SAME DAY SHIPPING



Panasonic I45 & I75's

WE STOCK
EVERY MODEL USED.

CALL NOW FOR
WHOLESALE PRICING

TOLL FREE: 800-322-9690



FAX: 516-246-5634

sizes. These days, most people who can afford them do prefer the newer, faster, and vastly more flexible inkjet systems. But these old models still work just fine if you are on a low budget. Even in E-size, they are sometimes bargain priced and probably can be converted into such things as vinyl sign cutters or silkscreen mask makers as well.

Industrial Furnaces — Insulated boxes from *Lindberg* or *Aremco* easily hit temperatures of a thousand degrees or more and are now available at sane prices. Besides obvious arts and crafts uses, what can you do with one?

Space Shuttle Receivers — Data boxes which directly can receive 2287.5 MHz video are rather specialized, but these include a bandpass filter, attenuator, fancy receiver, even a quality power supply. There is all sorts of satellite monitoring potential here.

Telemetry Downlinks — Also known as Artery receivers, these unusual gray boxes offer lots of fancy fiber optic O combined with some expensive-looking small gold-plated VHF radio modules. Plus an easily modified 8035 computer and display.

Sick Optics — Most precision optics are extremely expensive. But sometime's you can find chipped or cracked items that work just fine for school demos or home experiments. For instance, badly mauled corner reflectors could often be masked or "stopped down" to create smaller and cleaner cubes. A retroreflector returns a light beam in the exact direction it came from.

Inclinometers — These sensors always know which way is up. Also known as *electronic levels*, the fancy rugged devices get installed on construction equipment for levelling. Some use the differential capacitance of a sloshing liquid in its butterfly-shaped

sensor. The better ones are servo-driven null seekers. Lots of possibilities here.

Plate Thru Labs — Yes, it is possible to do your own double sided plate thru printed circuit boards. No, these are neither cheap or simple. *Kepto* is the leading source. These can sometimes be found as electronic surplus.

Tail Twisters — It turns out the HVAC air conditioning folks have long used power servos. Honeywell's Modutrol is one example. These are intended for damper controls, but are useful to open or close valves or similar apps. Typically moving 90 degrees in half a minute with up to 35 inch pounds of torque. This is the same as applying 17.5 pounds of twist to a three inch diameter valve handle. More on Modutrols in MUSE130.PDF.

Mystery Beer Coolers — Not sure what these are, but the feds got conned into paying \$21,000.00 for the pair of them. They called them "ion gauges." Maybe so, maybe not. Try to picture a liquid hydrogen Dewyer around 18 inches in diameter and two feet high. A special probe reaches inside via an expensive looking vacuum fitting. There's some small electronics externally attached. EG&G Ortec is the brand. Definitely for sale cheap. You can use it for superconductivity demos or low-noise amplifier experiments. For more details, contact casholsen@zianet.com.

Huge Light Bulbs — Airport beacons at one time needed large and impressive 1200-watt incandescent lamps. These are now cheaply available and make superb test loads, process heaters, or high intensity lights. These also seem just bizarre enough to make a rather nice "monode" addition to an antique vacuum tube collection.

Extension Phone Lockouts — These low-cost 2960 modules from the Northern Telecom folks

include a pair of 17-volt bilateral switching diodes. One use is to stop a picked up extension phone from blasting an ongoing modem or fax. Full schematics and more device details can be found in MUSE96.PDF and MUSE112.PDF.

Mechanical Timers — Stock "washing machine" timers consist of a small AC motor and scads of fairly heavy duty cam-driven contacts. They are easily converted into such things as hot tub, farm, or irrigation controllers. It's a real challenge to discover what you *really* can do with these beasts. New ones are readily available surplus or try your local dump.

Two Contests

Let us have two different contests this month. First, the Catfinder folks have agreed to a special contest only for readers of my columns. Just tell them something new or unusual that you'd like to do with one or more catfinders. They'll award a dozen or more free evaluation units to what they feel are the most interesting.

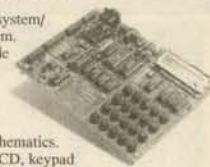
Send all of your entries on this one *directly* to the Catfinder address in the sidebar, or E-Mail jgcurtis@inreach.com. Getting back to the usual stuff, just tell me about any fresh new tech toy you've found to play with. One that I haven't heard of before. There will be a dozen or more of my *Incredible Secret Money Machine* III books going to the better entries. Plus an all expense paid *tinaja* quest for two (FOB Thatcher, AZ going to the very best of all).

Send your written and snail-mailed entries on this second contest directly to me here at *Synergetics*. Please be sure to keep these two contests separate.

Let's hear from you. NV

Learn MICROCONTROLLERS EMBEDDED SYSTEMS and PROGRAMMING...

with the AES learning system/ embedded control system. Extensive manuals guide you through your development project. All programming and hardware details explained. Complete schematics. Learn to program the LCD, keypad digital, analog, and serial I/O. for your applications.



THREE MODELS AVAILABLE. Choose from an Intel 8051, Intel 8088, or Motorola 68HC11 based system. All models come with:

- 32K Byte ROM, 32K Byte RAM • 2 by 16 Liquid Crystal Display • 4 by 5 Keypad • Digital, Analog, and Serial I/O • Interrupts, timers, chip-selects • 26 pin expansion connector • Built-in Logic Probe • Power Supply (can also be battery operated) • Powerful ROM MONITOR to help you program • Connects to your PC for programming or data logging (cable included) • Assembly, BASIC, and C programming (varies with model) • Program disks with Cross Assembler and many, well documented, program examples • User's Manuals: cover all details (over 500 pages) • Completely assembled and ready to use • Source code for all drivers and MONITOR • Optional Text Book

Everything you need. From \$279

Money Back Guarantee

Call for Free Info Pack, or see

WEB at <http://www.aesmicro.com>

714-550-8094, FAX 714-550-9941

Call 1-800-730-3232

AES
Advanced Educational Systems

AES 575 ANTON BLVD., SUITE 300, COSTA MESA, CA 92626, USA

Microcomputer pioneer and guru Don Lancaster is the author of 35 books and countless tech articles. Don maintains his no-charge US tech helpline found at (520) 428-4073, besides offering all of his own books, reprints, and consulting services. Don is the webmaster of his Guru's Lair found at <http://www.tinaja.com>.

You can reach Don at Synergetics, Box 809, Thatcher, AZ 85552. Or send any messages to don@tinaja.com.

WHOLESALE CABLE

COMPLETE LINE OF CABLE PRODUCTS

- ☒ Quality merchandise by brand name manufacturers
- ☒ Satisfaction guaranteed
- ☒ Free gift on first order
- ☒ Technical support
- ☒ 2 year warranty on new converters
- ☒ COD shipping & overnight shipping by request
- ☒ Experience where it counts
- ☒ Volume pricing

PLAIN CONVERTERS: ZENITH, OAK, PANASONIC, PIONEER, EAGLE, HAMLIN, STARGATE, PLUS MORE.

REMOTE CONTROLS: ALL MAJOR BRANDS, INCLUDING 2-4 FUNCTION UNIVERSAL REMOTES

WHOLESALE CABLE M-F 11am-6pm EST (800) 909-4333
(718) 262-0900 • FAX (718) 657-4015 • (718) 297-9221

No NY sales. Federal and local laws provide criminal and civil penalties for unauthorized use. Check with your cable providers for permission to use equipment. Must be paying for all services you receive. Order by model number only. Some equipment refurbished as new.



Tell us the best price you were offered, where you got it from, and let us try to beat it.



Equipment Management Technology
From Acquisition to Disposition

BUY * RENT * SELL

Quality

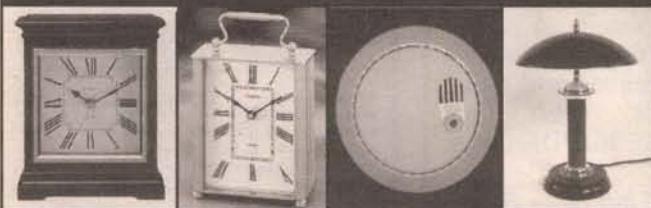
Test and Measurement Equipment

We inventory HP, Tektronix, Fluke, Anritsu, Wiltron, Iwatsu, Wavetek, GenRad and many other manufacturers. Our product lines include RF & microwave, oscilloscopes, generators, supplies, communications, voltage and frequency standards. Call us now for a quote!

Tel 650-631-1700 * Fax 650-631-1200 * email sales@emt1.com

www.spysite.com

COVERT SURVEILLANCE: Protect Your Assets



MC-985 \$350 CL-985 \$350 SD-985 \$295 VL-985 \$350

EXIT SIGN
CAMERA
EX-985 \$295

EMERGENCY
LIGHT
CAMERA
EL-985 \$325

All "985" Series Color Cameras Feature:

- Sensor: 1/3" Sharp® Color CCD
- Resolution: Over 380 TV lines
- Sensitivity: Super Low, 2 Lux
- Built-In Backlight Compensation
- Lens: 3.7 mm Pinhole
- Viewing Angle: 92 FOV
- Video Output: Female RCA
- Power: 5V DC (included)

CLOSEOUT

Color Camera Kit:

- 1/2" Sony Color CCD
- 400 TV line Res.
- 2 lux Sensitivity
- Backlight Compensation
- 4 mm Standard Lens
- Wall Mounting Kit
- 5V Power Transformer

SONY-1002 \$175

Counter Surveillance: Protect Your Privacy

Protect Yourself From:

- Telephone Taps
- Room Transmitters
- Body Wires



Built-In White Noise Generator

AI-5500 \$380

Detects Concealed:

- Tape Recorders
- Video Cameras
- Body Transmitters
- Room Transmitters



LED and Vibration Alert

TRVD-900 \$450

Your Payment Options: Credit Card, Cashier's Check, or Money Order

AMERICAN INNOVATIONS, Inc.

119 ROCKLAND CENTER ~ Suite 315 NANUET, NY 10954

Voice: (1)914-735-6127 Fax: (1)914-735-3560

Write in 209 on Reader Service Card.

Celebrating our 16th Year Of Service !!

COLLIMATING LENS

This economical collimating lens assembly consists of a black anodized aluminum barrel that acts as a heat sink, and a glass lens with a focal point of 7.5mm. Designed to fit standard 9mm laser diodes. Simply place diode in the lens assembly, adjust beam to desired focus, then set with adhesive.

STOCK 1-9 18-25 25-
LLENS Lens Assembly 24.99 23.74 21.37

DIODE/TRANSISTOR TESTER KIT

This dynamic tester allows checking of transistors & diodes in circuit. Identifies NPN or PNP transistors. Checks all types, small or large power. Identifies anode or cathode of diodes.

STOCK 1-9 18-25 25-
DT100K 24.99 23.74 21.37

ANTI-STATIC FOAM CLEANER

A thick, foaming cleaner for use in static sensitive applications. Safe for plastics and fiberglass. Use on computer cases and all office equipment. Also cleans soft fabrics. 5 oz. aerosol can.

STOCK 1-9 18-25 25-
SB1102 1.99 1.89 1.70

EPROMS

STOCK	1-24	25-39	100+
2716	2.99	2.84	2.56
2732	4.49	4.27	3.84
2732A-20	5.39	5.12	4.61
2764-20	5.39	5.12	4.61
2764-25	4.49	4.27	3.84
2764A-20	3.49	3.32	2.99
2764A-25	2.99	2.84	2.56
27C64-15	2.99	2.84	2.56
27256-15	4.79	4.55	4.10
27C256-15	2.99	2.84	2.56
27512-25	3.09	2.94	2.65
27C512-25	2.99	2.84	2.56
27C010-15	3.79	3.60	3.24
27C020-15	4.49	4.27	3.84
27C040-12	6.29	5.98	5.38
27C080-12	12.99	12.34	11.11

7400 SERIES I.C.'s

STOCK	1-24	25-39	100+
7400	.29	.28	.25
7402	.19	.18	.16
7404	.29	.28	.25
7406	.27	.26	.23
7407	.33	.31	.28
7408	.33	.31	.28
7410	.19	.18	.16
7411	.55	.52	.47
7414	.27	.26	.23
7420	.24	.23	.21
7432	.33	.31	.28
7447	.89	.85	.77
7473	.79	.75	.68
7474	.33	.31	.28

FM MICROPHONE KIT

Transmit your voice on any FM radio. Range up to 1000'. Case included.

STOCK 1-9 18-24 25-
K30 11.99 11.39 10.25

What Do We Have ?

- I.C.'s
- Oscillators
- Crystals
- Diodes
- Tools
- Laser Diodes
- Vises
- Resistors
- Capacitors
- Connectors
- Trimpots
- Kits
- Vises
- LED's
- Transistors
- And more!

GADGETEER'S GOLDMINE

This exciting collection of electronic projects features experiments ranging from magnetic levitation and lasers to high-tech surveillance and digital communications.

• By Gordon McComb

STOCK 1-9 18-24 25-
TB3360 21.99 20.89 18.80

- Order Line — (800) 824-3432 • International — (724) 495-1230 • Fax Orders — (724) 495-7882
- Technical Support — (724) 495-1231 • No Minimum Order — (Orders under \$20 subject to \$5 charge) • UPS 3 day, Blue, Red, & Fed. Ex. Shipping Available (Call for charges) • PA Res. Add 7 % Sales Tax • Open Mon-Fri 9:00 AM - 5:00 PM (EST) • Corporate Accounts / Quantity Discounts Available • We accept M/C, VISA, Discover & American Express with no surcharge • Call For FREE Catalog (\$2.00 Outside U.S.)
- We Carry A Complete Line Of Electronic Components • Email - unielect@aol.com

FREE SHIPPING!!

on pre-paid orders

Unicorn Electronics
1142 State Route 18
Aliquippa, PA 15001

Write in 208 on Reader Service Card.

Newsbytes

COMPLIANCE AND INFORMATION ACTION

Ship radio inspections to be privatized.

In compliance with the requirements of the Telecommunications Act of 1996, the Commission has amended its rules to permit it to use FCC-licensed technicians in private sector organizations to inspect all US ships required to be inspected for compliance with the Communications Act of the International Convention for the Safety of Life at Sea.

Commission inspectors currently conduct inspections of a ship's required radio equipment for compliance with the Communications Act or the Safety Convention.

The FCC inspects approximately 1210 vessels each year. To be in compliance with the current rules — that require that all inspections be conducted by the Commission — the FCC has had to hire part-time ship inspectors in remote areas such as Guam and has traveled great distances to inspect radio stations on US ships.

The Commission estimates that total annual personnel required to inspect these ships is 15.5 full-time employees and travel costs to be \$50,000.00 a year. The new rules will relieve the FCC of these manpower and financial burdens, while permitting vessels the more convenient and cost-effective alternative of using FCC-licensed technicians from the private sector for inspections.

The new rules incorporate requirements suggested by the United States Coast Guard to ensure that maritime safety is not compromised. The new rules result in the following benefits:

- Privatization will increase the number of experienced entities available to inspect the radio stations of ships.
- Privatization will permit ship owners and operators to arrange for inspections at any time or place.
- Privatization should not adversely affect safety. The rules incorporate changes suggested by commenters that will require the use of a standard inspection check list with the FCC maintaining oversight of the inspection process as suggested by the US Coast Guard.
- Privatization will decrease administrative burdens on the Commission by shifting the responsibility to arrange ship inspections from Commission to ship owners or operators.



MICROTECH ANNOUNCES USB-TO-SCSI CONVERTER

Low-cost connectivity solution brings flexibility to iMac owners.

Microtech International will now manufacture and ship a converter cable that allows SCSI storage devices to be connected to a standard USB port. The Microtech Xpress USB is a USB-to-SCSI converter which targets the hundreds of thousands of new iMac owners who may own older SCSI peripherals, such as hard drives, SyQuest, CD-ROM, or Iomega Zip and Jaz cartridge drives.

With an MSRP of just \$79.00, the USB-to-SCSI converter offers an affordable solution, filling a void created by the connectivity limitations of the iMac.

The converter is designed as a cable with a standard USB con-

connector on one end, and a male SCSI DB25 connector at the other. The SCSI connector is attached to the external drive and the hot-swappable USB connector is plugged in to the CPU or hub. The connector supports up to seven devices in true plug-and-play fashion, recognizing devices on the fly without requiring users to restart the computer.

The Xpress USB is fully compliant with the USB spec version 1.0, and delivers a maximum data throughput rate of 1.2MB/sec.

The first release of the software driver for the connector will support storage devices including Winchester drives and all removable media solutions. Microtech also promises an aggressive development schedule for driver updates and expects to support scanners and other third-party devices in upcoming revisions. All driver upgrades will be free-of-charge and available for download from the Microtech website.

Specific questions regarding compatibility and product support can be directed to Microtech Technical Support at 1-800-666-9689, or via E-Mail at nagy@microtechint.com.

Microtech expects to be shipping in volume on January 4, 1999, in time for MacWorld San Francisco. Units will be available through standard distribution channels, including Ingram Micro and Pinacor.

Information on all Microtech products is available at: <http://www.microtechint.com>.



TELEVISION COMMERCIALS FOR THE INTERNET

COMMERCIAL TV.COM now has available INTERCOMMERCIALS on the Internet. This is a new form of television commercial geared for the Internet. Commercial TV.Com is an Internet company that deals with surveys of television commercials and intermercials on the Internet.

It is assumed the Internet will soon become the focal point of many households and

corporations. Currently, commercials are produced for the television industry, but many companies are shifting gears to ride the high profile Intermercials and the mass exposure at a cost-effective price that the Internet will offer.

Give Commercial TV.Com a call at 1-800-700-8749 if using intermercials as a mass marketing tool applies to your situation. **NV**

How many shopping days til Christmas?

If you're looking for that perfect gift for the hard-to-please electronics enthusiast, why not surprise them with a gift subscription to **Nuts & Volts Magazine**!?!

Order today!

Nuts & Volts Magazine
430 Princeland Court, Corona, CA 91719
800-783-4624 • 909-371-3052 FAX
<http://www.nutsvolts.com>

47pc•kit

\$12.95

MK101
SWEETHEART

Give him or her that special heartbeat. 28 leds form 2 blinking hearts. Power supply : 9V battery

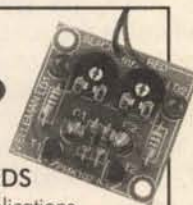


14pc•kit

\$5.95

MK102
FLASHING LEDS

For different applications (such as model construction) and educational purposes. Adjustable flashing speed. Power supply : 9V battery



30pc•kit

\$14.95

MK104
ELECTRONIC CRICKET

This cricket turns on when it gets dark. Great as practical joke. The tone and repetition between two crickets is adjustable. Power supply : 9V battery



34pc•kit

\$9.95

MK103
LED SOUND-TO-LIGHT UNIT

For different funny and practical applications. 4 high-intensity leds light up and react simultaneously on every sound. Power supply : 9V battery

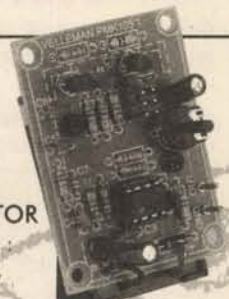


36pc•kit

\$10.95

MK105
SIGNAL GENERATOR

Several signal outputs : square wave, triangle, sine and integrator which are selectable with a jumper. The signal frequency is about 1KHz (fixed) Ideal to learn electronics! Power supply : 9V battery



26pc•kit

\$14.95

MK106
METRONOME

The beats per minute are given by a built-in speaker and by a led. Adjustable volume, beats per minute and sound. With on/off switch. Power supply : 9V battery



36pc•kit

\$12.95

MK107
LED RUNNING LIGHT

8 leds running light. Different running effects are selectable (by prog push button). Adjustable effect speed. Power supply stand-by by push button. Power supply : 9V battery



8pc•kit

\$7.95

MK108
WATER ALARM

Never let you surprise by flooding! Gives alarm sound when water is detected. Incorporated alarm buzzer. Water sensor can be placed at distance by cutting the board and using wires to connect the sensor. Power supply : 9V battery



35pc•kit

\$9.95

MK109
ELECTRONIC DIE

No more cheating allowed! The eyes of the die are leds. Rolls out when the push button is released. Power supply : 9V battery



17pc•kit

\$12.95

MK110
SIMPLE ONE CHANNEL LIGHT ORGAN

With loudspeaker input. The lamp flashes on the beat of the music. Optical isolated loudspeaker input with adjustable sensitivity : 2W to 60W. Maximum load : 120W at 120Vac.



17pc•kit

\$19.95

K5300
STROBOSCOPE

Adjustable flash frequency : 5-15Hz. Power supply : 120Vac. Power consumption : 13W max.



21pc•kit

\$12.49

K2637
SUPERMINI 2.5W AUDIO POWER AMPLIFIER

Superb audio amplifier with incredible tiny dimensions. Integrated circuit has a pre- and power amplifier which can be used separately. Max. output power : 2.5W @ 4ohm. Frequency characteristics : 60Hz to 15KHz. Power supply : 4.5V to 15Vdc / 400mA.



Exists also as module : M2637 **\$17.49**

velleman

7415 Whitehall Street Suite 119
Fort Worth, TX 76118
(817) 284-7785 F : (817) 284-7712
www.velleman.be email : velleman@earthlink.net

Questions ? Contact us for a list of US distributors or to get your **FREE** catalogue

Build AN AIR JOYSTICK

It occurred to me, as I looked out the cockpit of my P-51 Mustang, that my plane's controls were kind of sluggish. However, off in the distance, I could see the German ME-109s coming at me in attack formation. I tried to roll out but just couldn't make the turn. My controls just wouldn't respond.

They were all over me. I was hit and hit again. One by one, the enemy strafe my wings. Then, it was all over ... it was the stupid controller.

I was using a normal Sega controller and it was just not designed to simulate an aircraft joystick. The game was fine, but I needed a better way to simulate the controls of the plane.

There are joysticks out there, but they all suffer from the same problem: They use two hands. What I needed was a one-handed joystick. It should respond by tilting the grip, but be constrained by a base. What I needed was an air joystick.

I have designed and built an air joystick that works by using mercury switches for the directional controls. It will work with any Sega Genesis game machine, can be made from easily-obtained parts, and costs about \$15.00 to build.

Before we build our air joystick, we must understand how the Sega controller works. The normal controller has eight switches in it: four for direction and four for functions (A, B, C, START). These eight signals are transmitted back to the Sega over six wires in the controller's cable. The other three wires are used

for ground five volts and a control signal.

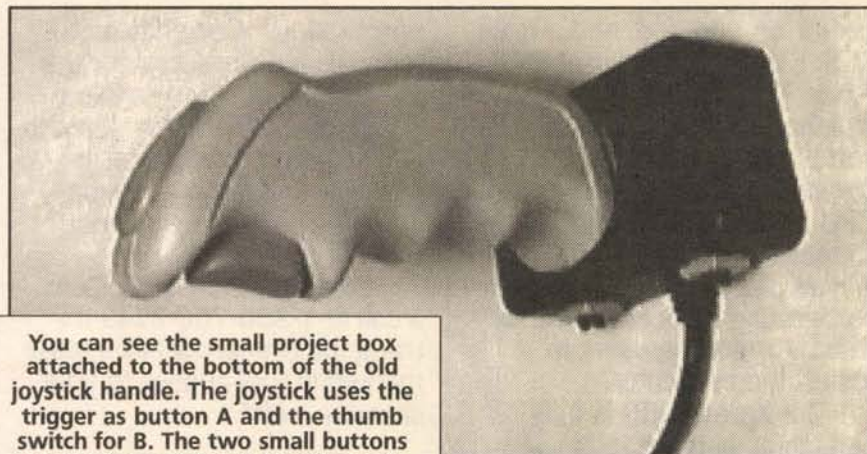
Since eight signals must be sent over six wires, the signals are arranged into two groups: A and B. The control signal sent from the Sega indicates which signals are requested.

To make this work, a chip is located inside the controller to route the correct signals requested by the Sega. The chip works like four relays working together. If the control signal is in a high (five volts) state, the RIGHT, LEFT, A, and START are sent. If the control is in a low (ground) state, the B and C are sent.

The UP and DOWN signals are not routed through the chip so they are present all the time. Some controllers have additional circuits to produce a machine gun effect with the fire buttons.

To make the air joystick work requires mercury switches (see Safety Note). These are similar to the mercury switches found in most home thermostats or silent light switches. As the switch is tilted, a tiny blob of mercury rolls from one end to the other inside a glass tube. At one end are two or three electrical contacts. When the mercury switch is tilted enough, the mercury rolls to the end with the contacts and completes the circuit. By positioning four mercury switches so each one represents one switch in the directional control, we can create a joystick.

I started building my joystick by obtaining an old, dead joystick. It doesn't matter what the joystick originally connected to since all we want is the grip. I found mine on a RadioShack clearance table, but any type will do. I was looking for a



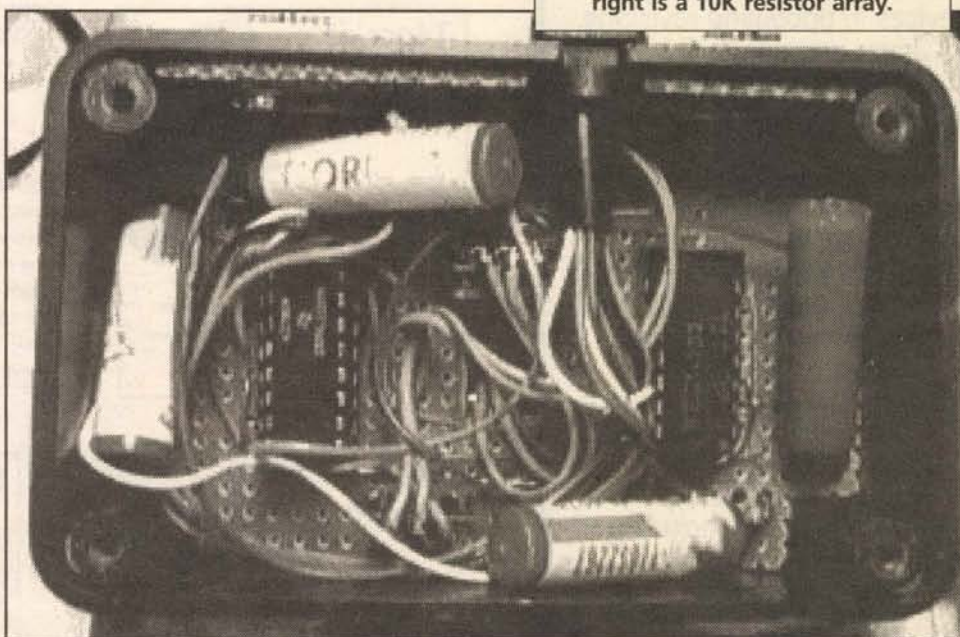
You can see the small project box attached to the bottom of the old joystick handle. The joystick uses the trigger as button A and the thumb switch for B. The two small buttons on the front of the project box are C and Start.

joystick that had at least two triggers; one for the index finger and one for the thumb. If you can find a joystick that has two or three thumb switches, that will work better.

Disassemble the joystick and discard everything but the grip. I thought about using the old joystick base to house the electronics, but the original base was oversized and too heavy for my use. Also there is a

to fit into the box. I used a utility knife and nibbling tool to trim the board to fit within the box. This might take several tries of trimming and test-fitting before the board fits correctly. When the board is finished,

This photo shows the electronics inside the air joystick. The small mercury switches (small tubular) are visible along the walls of the project box. They are tilted at approx. 30 degrees. The 74LS157 is the chip on the left while on the right is a 10K resistor array.



tendency to use it like a normal joystick.

When disassembling the joystick, keep the wires running to the triggers as long as possible. They will need to be about two to three inches long. If the wires are too short, open up the handle and extend the wires. The smallest project box RadioShack sells is perfect for our use.

Based on the joystick you started with, drill a hole in the center of the project box large enough for the trigger wires to pass through. This hole must be centered so the weight of the project box and electronics will be balanced. Attach the joystick handle to the project box with small screws. The box should be oriented so the narrow part of the box is forward and the wider part of the box is side-to-side (see photo). This will distribute the weight better and make it easier to use. Remember this joint should not flex, but must stand up if someone grabs it by the base.

Now we must trim the PC board

it should fit snugly at the bottom of the box. Drill a hole in the center of the PC board to accommodate the trigger wires as they pass through the box. The PC board will be the support and connection for all the remaining components.

Start by positioning the mercury switches so that each switch is at the edge of one main axis (up, down, right, left) of the PC board. It is best to position each switch so they all point in a clockwise or counter-clockwise fashion. This way each will rep-

SAFETY NOTE

Mercury switches are made of liquid mercury encased in a glass capsule. Care must be taken to see they are handled properly. Mercury switches are safe as long as the glass remains unbroken. MERCURY IS A DANGEROUS SUBSTANCE AND SHOULD NOT BE HANDLED FOR ANY LENGTH OF TIME. If a mercury switch becomes damaged or breaks, contact local authorities about disposal. UNDER NO CIRCUMSTANCES dispose of mercury switches in a fire, as mercury vapor is very poisonous.

by MARK HANSLIP
Photos by George Stanley

PRODUCTS FEATURES ORDER NEWS LINKS



Black Feather ELECTRONICS

Black Feather Electronics
10841 Noel St. #106
Los Alamitos, Ca. 90720

DIRECT DIAL: (714) 236-1776 FAX: (714) 236-1778 E-MAIL: bktea@juno.com

WWW.BLKFEATHER.COM

WE BUY EXCESS/SURPLUS ELECTRONIC SUPPLIES

the game Shove-it. The speed of the game was slow enough that my movements were easy to detect and I could see if the movement was correct. Games that require lots of fast movement will not work since your movements can't be tracked accurately.

The other way to test the joystick is to build a tester that will light an LED for each movement or button push. This tester can be as simple as a resistor and single LED or a device that will test all the functions of a controller at once. If you supply the joystick with ground, five volts, and a control input, a single LED can be used to see if the signal from a movement or button push is present on the correct pin.

If your joystick doesn't work perfectly at first, check for solder bridges and broken wires. Possibly the chip could be in the socket backwards. The angle of the mercury switches will affect how much they have to be rotated before a signal is returned. One mistake I made was to wire the UP and DOWN switches in reverse.

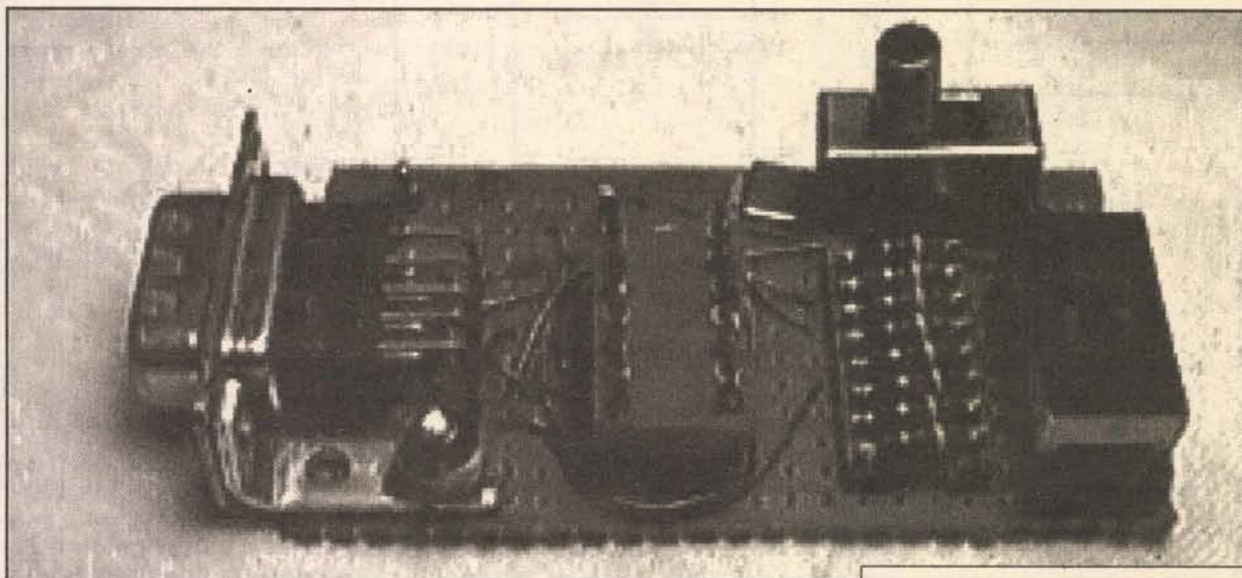
I was testing it on a aircraft flight game, so when I tilted forward, I normally expected the plane to descend and tilting back made the plane climb. This is correct for an airplane, but I found out that this is backwards for games. I re-wired the joystick. It was easier to think of it as a tank joystick where UP is forward and DOWN is reverse. By re-wiring, it makes it work like all other game controllers. It would be possible to add a DPDT slide switch to swap the UP and DOWN signals as required.

Now that you have your new air joystick, put on your VR helmet and fly that mission like it was meant to be flown, and kill a few bad guys for me ...

by MARK HANSLIP

Photos by George Stanley

Build A SEGA CONTROLLER TESTER



This photo shows how simple the tester truly is. The controller being tested plugs into the connector on the left. The switch and LED display are on the right. In the middle of the board is a jumper block that was originally used to test the tester.

"Dad, the Sega controllers are messing up again. Can you fix them please?" Oh, the joys of being a parent. It amazes me how much abuse a video game control can take, and even more how much my son can dish out. I have replaced cords, contact pads, and a variety of other things.

The problem with repairing game controllers is that you never quite know if the trouble is in the controller, the cable, or the machine itself. And once you have fixed the controller, you are not always quite sure if it's truly repaired. There is always the contact pads that shift and wires that get pinched.

The only way to test your repairs is to use the controller with a game that allows you to test all the

buttons and directions. This is almost impossible. And, very time-consuming.

To make my life simpler, I have designed a controller tester. It connects up to any Sega game controller and will display the output of all the buttons when pressed. This allows me to test the controller and find the problem, then test it later and see if my repairs have worked. The design is simple and easy to construct. I built mine in less than an hour with parts I had on hand.

A Sega controller uses a DB-9 female connector. Being a standard connector, this makes finding a mating connector very easy. The Sega was designed so that eight switches in the controller are attached to six wires in the cable. This means that sometimes two signals share one connector pin. To make this work, the Sega toggles pin 7 to enable the

"A" or "B" set of signals. The tester takes this into account by using a slide switch to simulate the toggling of pin 7. A 555 could be used to continuously toggle the control line, but this would make the circuit more complicated and make the output harder to read. The signals for each connector pin are located in List 1.

The basic circuit has +5 volts; ground and the control signal are outputs to the controller under test. The six outputs returning from the controller are connected to LEDs for display. I decided to use a seven-segment display to keep the design

Weeder Technologies

ON-LINE CATALOG
www.weedtech.com

Pro-Kit

PO Box 2426, Ft. Walton Beach, FL 32549

Voice/Fax 850-863-5723

Stackable RS-232 Kits

Digital I/O - 12 I/O pins individually configurable for input or output. DIP switch addressable; stack up to 16 modules on same port for 192 I/O points. Turn on/off relays. Sense switch transitions, button presses, 4x4 matrix decoding using auto-debounce and repeat. **\$32**

Analog Input - 8 Input pins. 12-bit plus sign self-calibrating ADC. Returns results in 1mV steps from 0 to 4095. Software programmable alarm trip-points for each input. DIP switch addressable; stack up to 16 modules on same port for 128 single-ended or 64 differential inputs. **\$48**

Home Automation (X-10) - Connects between a TW523 and your serial port. Receive/transmit all X-10 commands with your home-brewed programs. Full collision detection with auto re-transmission. **\$39**

Caller ID - Decodes the caller ID data and sends it to your serial port in a pre-formatted ASCII character string. Example: "12/31 08:45 850-863-5723 Weeder, Terry <CR>". Keep a log of all incoming calls. Block out unwanted callers to your BBS or other modem applications. **\$35**

Touch-Tone Input - Decodes DTMF tones and sends them to your serial port. Keep a log of all outgoing calls. Use with the Caller ID kit for a complete in/out logging system. Send commands to the Home Automation and/or Digital I/O kits using a remote telephone. **\$34**

Phone Line Transponder

7 individual output pins are controlled with buttons 1-7 on your touch-tone phone. Automatically answers telephone and waits for commands. Monitor room noises with built in mic. "Dial-Out" pin instructs unit to pick up phone and dial user entered number(s). Password protected. **\$48**

DTMF Decoder/Logger

Keep track of all numbers dialed or entered from any phone on your line. Decodes all touch-tones and displays them on a 16 character LCD. Holds the last 240 digits in non-volatile memory. Connect directly to radio receiver's speaker terminals for off-air decoding of repeater codes, or numbers dialed on a radio program. **\$55**

IR Remote Control Receiver

Learns and responds to the data patterns emitted by standard infrared remote controls used by TVs, VCRs, Stereos, etc. Lets you control all your electronic projects with your TV remote. 7 individual output pins can be assigned to any button on your remote, and can be configured for either "toggle" or "momentary" action. **\$32**

Telephone Call Restrictors

Two modes of operation; either prevent receiving or placing telephone calls (or call prefixes) which have been entered into memory, or prevent those calls (or call prefixes) which have "not" been entered into memory. Use touch-tone phone to program.

Block out selected outgoing calls. Bypass at any time using your password. **\$35**

Block out selected incoming calls. Calls identified using Caller ID data. **\$48**

Merry Christmas and a
Happy New Year!!

ABC ELECTRONICS 315 7TH AVE N. MPLS. MN. 55401
(612)332-2378 FAX (612)332-8481 E-MAILSURP1@VISI.COM

WE BUY TEST EQUIPMENT AND COMPONENTS.

VISIT US ON THE WEB AT WWW.ABCTEST.COM

HP 54501A 100MHZ DIGITIZING SCOPE	\$1300.00	HP 4935A TRANS IMPAIRMENT TEST SET	\$900.00
HP 54201D 300MHZ DIGITIZING SCOPE	\$1000.00	HP 5006A SIGNATURE ANALYZER	\$150.00
HP 54201A 300MHZ DIGITIZING SCOPE	\$1000.00	HP 86602B 1MHZ-1300MHZ RF PLUG	\$400.00
HP 54200A 50MHZ SCOPE/WAVEFORM ANALYZER	\$700.00	EIP 575 MICROWAVE COUNTER	\$1500.00
HP 3312A 13MHZ FUNCTION GENERATOR	\$250.00	FLUKE 95 50MHZ SCOPEMETER	\$550.00
HP 5370A 100MHZ U.T.I. COUNTER	\$400.00	LECROY 7200 400MHZ O-SCOPE	\$1000.00
HP 3586C LEVEL METER	\$750.00	TEK 475 200MHZ O-SCOPE	\$500.00
HP 436A POWER METER W/O SENSOR&CABLE	\$500.00	TEK 465 100MHZ O-SCOPE	\$400.00
HP 8350B SWEEP OSCILLATOR MAINFRAME	\$2000.00	TEK 496P 1KHZ-1.8GHZ SPEC. ANALYZER	\$3500.00
HP 3437A 3.5DIGIT SYSTEM VOLT METER	\$250.00	TEK 1240 LOGIC ANALYZER	\$750.00
HP 3455A DIGITAL MULTIMETER	\$250.00	TEK TDS320 100MHZ DIGITAL O-SCOPE	\$1400.00
HP 3456A DIGITAL MULTIMETER	\$400.00	TEK 11401A 500MHZ PROG O-SCOPE FRAME	\$750.00
HP 3336C SYNTHESIZER/LEVEL GENERATOR	\$800.00	TEK 7854 400MHZ OSCILLOSCOPE FRAME	\$500.00
HP 3325A SYNTHESIZER/FUNCTION GENERATOR	\$1000.00	TEK 7904 400MHZ OSCILLOSCOPE FRAME	\$250.00
HP 5335A 200MHZ COUNTER	\$600.00	TEK 7A26 200MHZ VERTICAL PLUG	\$75.00
HP 8165A PROGRAMMABLE SIGNAL SOURCE	\$1100.00	TEK 7A24 400MHZ VERTICAL PLUG	\$150.00
HP 8558B/181 100K-1500MHZ SPECTRUM ANALYZER	\$1000.00	TEK 7B80 400MHZ TIME BASE	\$75.00
HP 8559B/183 10MHZ-21GHZ SPECTRUM ANALYZER	\$3000.00	TEK 7B92A 500MHZ DUAL TIME BASE	\$125.00
HP 1740A 100MHZ OSCILLOSCOPE	\$250.00	TEK 7S12 SAMPLING PLUG	\$250.00
HP 6034A 60VDC-10A POWER SUPPLY	\$750.00	TEK 7L14 10KHZ-1.8GHZ SPEC. ANALYZER	\$1000.00
HP 6269B 40VDC-50A POWER SUPPLY	\$800.00	TEK AM503 CURRENT PROBE AMPLIFIER	\$250.00
HP 6553A 40VDC-12.5A. POWER SUPPLY OPT J01	\$1200.00	WAVETEK 145 20MHZ PULSE/FUNCTION GEN.	\$400.00
HP 6632A 20VDC-5A POWER SUPPLY	\$500.00	WAVETEK 182A 4MHZ FUNCTION GEN.	\$150.00
HP 6643A 45VDC-4.3A POWER SUPPLY OPT J03	\$750.00	WAVETEK 955 7.5-12.4GHZ MICROSOURCE	\$1100.00

List 1: CONTROLLER SIGNALS

PB-9	SIGNALS
1	UP (both a and b)
2	DOWN (both a and b)
3	LEFT (b) unused (a)
4	RIGHT (b) unused (a)
5	+5 volts
6	"A" (a) "B" (b)
7	CONTROL PIN A=GND B=+5
8	GROUND
9	"START" (a) "C" (b)

List 2: PARTS LISTRADIO SHACK

PC board	276-158
DB-9 male	276-1538
6 220 ohm 1/4Ww	271-1313
2.2K 1/4W	271-1325
Seven-segment display	276-075
Common anode (or 6 individual LEDs)	
SPST switch	275-645
14 pin IC socket	276-1998

List 3: REPLACEMENT PARTS SOURCES

Parts to repair Sega controllers can be obtained from MCM Electronics, 1-800-543-4330 (Cable 83-385; Contact pads 83-1580).

List 4: LINEOUT FOR SEVEN-SEGMENT DISPLAY

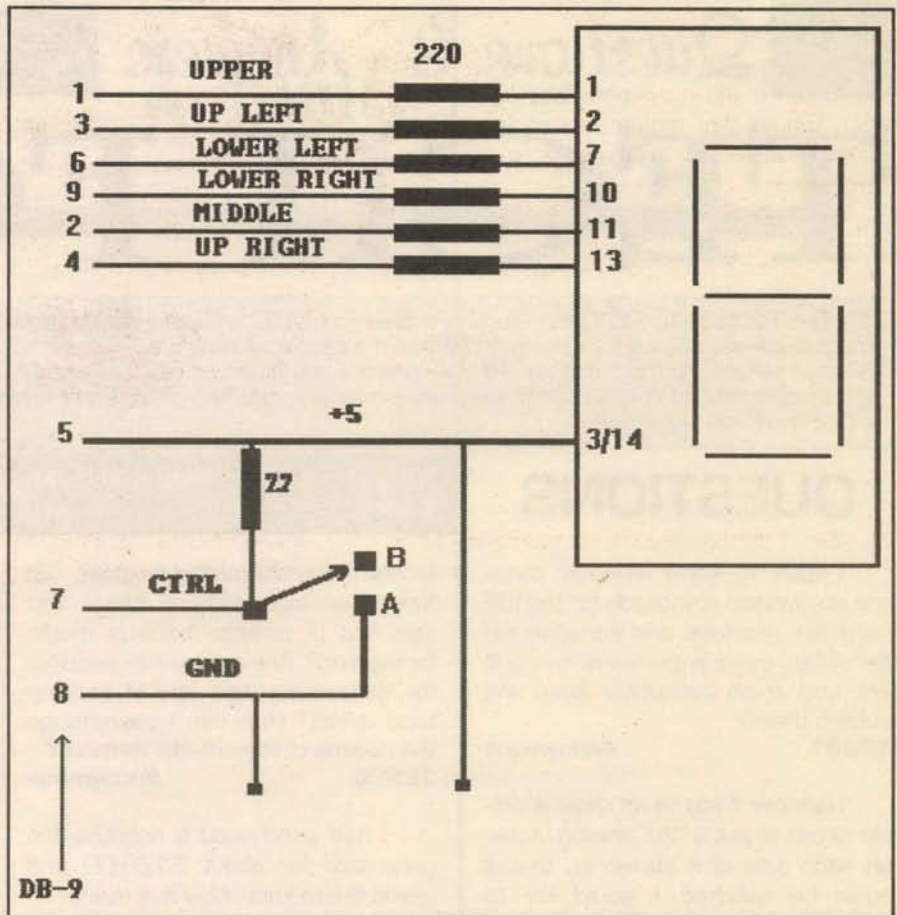
PIN	USE
1 TOP	UP
2 UPPER LEFT	LEFT
3 +5	
7 LOWER LEFT	A/B
10 LOWER RIGHT	C/START
11 MIDDLE	DOWN
13 UPPER RIGHT	RIGHT
14 +5	

the middle bar is "DOWN," the left LED is "LEFT," and the right LED is "RIGHT."

I used the lower left and right as the display for the A, B, C, and START buttons. An external power source of +5 volts will be needed to power the controller and tester. Sega controllers contain a 74157 IC so the operating voltage cannot vary too much from +5 volts. A possible alternative is to use a nine-volt battery and a five-volt regulator.

To test a controller, plug it into the connector on the tester. Set the switch to "B" (five volts) and start by pressing each of the direction buttons. With each press, the corresponding LED should light. Next, press "B" and "C." These should each light a lower leg of the display.

To test the "A" set, slide the switch to the "A" position. The upper right and left LED will light and stay on, but the top and middle LED will still respond to the normal directional buttons. This is normal. Pressing the "A" and



"START" buttons will each light one of the lower legs of the LED display. If any LEDs fail to light when the appropriate button is pressed, a problem has been found within the controller.

This tester will save you a

tremendous amount of time. It will help you to correctly replace contact pads, locate broken cables, and other problems with controllers.

It even helped me build and test a special joystick for my son, but that's another story ... NV

small and simple. I used the upper part of the "*" to display the directional controls. The top LED is "UP,"

top and middle LED will still respond to the normal directional buttons. This is normal. Pressing the "A" and

Robotics
Lasers
Communications
Computers
Microcontrollers
Automation
Alternative Energy
Much More!



ARE YOU MISSING ANY ISSUES OF NUTS & VOLTS?

BACK ISSUES ARE AVAILABLE FOR ONLY \$5.00 EACH!

CALL OUR ORDERLINE AT 800-783-4624 AND USE YOUR VISA OR MASTERCARD. PRICE INCLUDES FIRST CLASS POSTAGE.

SUPER RANGE FILTERED BLACKLIGHT TUBE

Great for lighting blacklight posters, detecting invisible UV inks, counterfeit currencies, certain UV minerals, etc. Type M00LIM F4T5 BLB is 5 3/4" Long (including terminals). It lights up with a deep dark purple glow when powered up. Great for replacement or new construction. Produces mostly longwave UV light.

G9598 \$5.95 Sale \$3.49 ea. Expires 1-31-99

12VDC FLUORESCENT TUBE DRIVER BOARD

This sophisticated circuit board was designed to convert 12VDC to a high voltage needed to drive fluorescent tubes such as our blacklight tube or our white backlighted display panel. Simply connect 12VDC to the input terminals, connect start terminals together, and whatever tube you have connected to the output terminals will light up for about 1 minute. The board then needs to cool for a minute before you activate it again. Features a red "on" LED indicator. Size: 2-7/8" x 1-7/8".

G9614 \$1.89

6 OUTLET GROUNDED PLUG

This handy 6 outlet grounded plug converts any standard 2 outlet wall outlet (grounded type) to a 6 outlet plug. Simply plug it into your existing wall outlet. Rated 120VAC, 15amps, 1800 watts. Brand new.

G9824 \$3.98 ea.

PRIME "C" SIZE FAST CHARGE NICADS

High power fast charge nicads rated 1.2V 2.4amps. These have been removed from brand new packs and do not have the vinyl sleeves. They do have solder tabs for easy hookup. Can be recharged over and over!

G9862 1 "C" Cell 89¢ ea.

G9863 3 "C" Cells (Connected together) \$2.49

MAGIC CHRISTMAS TREE KIT

This unique kit is sure to surprise all who see it! The kit shows a colorful Christmas tree which has 3 white looking bulbs (actually LEDs). When a 9V battery (not included) is connected, the bulbs on the tree blink all red then all green and then back to red again. The effect is magic! Size of PC board: 2 1/2" x 2 5/8". Circuitry uses 4 transistors to produce this unique display and a color label which you glue to the PC board before you start assembling the kit. Complete with all parts, label, PC board and instructions. Skill Level 1.

C6773 \$6.50

SUPER BREADBOARD

Compact breadboard for making prototype circuits features 60 groups of 5 connected terminal points. Handy for prototyping thousands of circuits. Each terminal firmly grips the lead or IC pin inserted into it. Reusable over and over again. Size 3 1/4" L x 1 3/8" W. White color plastic with peel and stick foam tape on base so you can mount it on a chassis if desired.

G9849 \$3.98

"THE BLINDER" LASER-LIKE LED

This red LED is one of the brightest we have ever seen! We don't know the MCD, but it must be high. Jumbo T1 3/4" (5mm) case with clear lens and long leads. The lens has a slight magnifying shape to it. Brand new prime! The brightest LED we sell.

G9601 4 for \$1.00 100 for \$22.00 1000 for \$200

POCKET-SIZED BATTERY TESTER

Handy tester checks "AAA", "AA", "C", "D" and "N" button cells and even 9V batteries. Now you will know for sure whether that battery is weak, dead or good. Size only 2" x 1 1/4" x 3/4". Brand new in sealed blister pack. Made by "It's a Snap Electrical Accessories." Model 71207.

G9562 \$2.49

ELECTRONIC GOLDMINE
PO Box 5408
Scottsdale, AZ 85261

WE ALSO OFFER OVER 150 DIFFERENT ELECTRONIC KITS.

<http://www.goldmine-elec.com>

NOTE: All items subject to prior sale; All prices expire 1-31-99

For Phone Orders Call: 800-445-0697
or Fax Your Orders to: (602) 661-8259
For a Free Catalog Call: (602) 451-7454
Foreign catalog request: send \$5.00

Minimum Order: \$10 (plus min. \$5 Shipping and Handling). We accept MasterCard, Visa and personal checks, however, we cannot accept personal checks on orders outside the U.S. Minimum Foreign Order Amount: \$50 (plus a minimum \$10 S&H)

DIGITAL DISPLAY PEN TYPE AC/DC VOLTAGE DETECTOR

This amazing device can detect AC volts, even through insulation, and can also be used as a handy continuity tester. It is very unusual in that it does not use batteries, yet provides indications on a small LCD display. As the probe tip is brought near a live wire, which is plugged into 120VAC a special symbol is displayed on the LCD display (no need to touch the probe tip to a live wire as it can detect the presence of AC through insulation). Will also measure approximate AC or DC voltage level from 12V - 220V AC or DC and will display a digital approximation (12V, 36V, 55V, 110V, 220V) if probe tip is touched to a "hot" wire. Can also identify blown fuses, circuit breakers, faulty insulation, etc. Very handy brand new in retail blister package.

G9569 \$2.98

TECH FORUM

This is a READER TO READER Column. All questions AND answers will be provided by *Nuts & Volts* readers and are intended to promote the exchange of ideas and provide assistance for solving problems of a technical nature. All questions submitted are subject to editing and will be published on a space available basis if deemed suitable to the publisher. All answers are submitted by readers and **NO GUARANTEES WHATSOEVER** are made by the publisher. The implementation of any answer printed in this column may require varying degrees of technical experience and should only be attempted by qualified individuals. Always use common sense and good judgement!

QUESTIONS

I want to know whether there are any written standards for the IDE hard disk interface, and the universal serial bus used in personal computers, and which institutions keep and publish them?

12981 **Anonymous**

I wonder if you could show a simple circuit to put a "VU" analog meter on each side of a stereo so that it could be watched. I would like to attach them between the stereo and the speakers, and be able to adjust the meters sensitivity, if possible.

12982 **B. E. Holtermann**
Bena, VA

On the Internet and in other documents, I see the use of the TCM3105 202 modem chip. It works well, but appears to be out of production. Is it second sourced or does someone have a big stash of them?

12983 **Neal Collier**
Pensacola, FL

I need the specs on GP1U52X IR receiver/demodulator, or at least the name of the manufacturer. I am trying to build an IR switch.

12984 **Bhavesh Parikh**
via Internet

I am looking for an inexpensive outbound call monitoring system, one that will keep a record of the numbers dialed from a given phone, along with the date and time of the call. I need to handle about 200 calls before any storage medium is overflowed.

RadioShack used to market a small unit that recorded the data on a roll of paper, but they do not offer it any longer. Inexpensive is the key here. While a stand-alone unit is preferable, a computer can be made available if needed. Kits or simply plans will also be considered.

12985 **Steve Bepko**
Baltimore, MD

I have a TEAC 700 computer back-up tape drive that works fine with a 3010 formatted tape. How can I low-level format a QIC Wide (as cartridge modified) or QIC 80 tape?

Using Arcadia or Microsoft back-up software, the head of the tape is

Send all material to **Nuts & Volts Magazine**, 430 Princeland Court, Corona, CA 91719, OR fax to (909) 371-3052, OR E-Mail to forum@nutsvolts.com

located, but the software does not format a tape. Where can I find specifics of strange back-up media formatting? Are programs available for general-purpose use of back-up tape drives? How can I interchange the dozens of tape media formats?

12986 **Anonymous**

I had purchased a negative Ion generator for about \$120.00 and would like to know how it is made.

I would like to make a more powerful one. It looks very simple, but the parts are encased in a hard plastic with no markings on the outside.

12987 **Patrick McGuinn**
via Internet

I need a simple countdown circuit to count from a preset value of 2-12 to zero. It needs to provide an output at zero. Levels are no problem. I can adapt to the voltages I need.

I have been out of this stuff for a long time. Last time I did this, I used a motor driving a disk with a wiper!

12988 **Dave Schoepf**
Marianna, FL

I was given a Genigraphics film recorder model# F.R. PSM 3 Rev.G. It included an ISA card. Does anyone know where I can get drivers for it?

12989 **Richard Coppola**
Bayside, NY

I have an enormous (24 lbs.) FUJITSU model M2312K 8" hard drive part# B03B-4595-B002A, date 1985-3. I am really curious about the specs on this piece of history — speed, interface type, capacity, original computer, etc.

129810 **Richard Coppola**
Bayside, NY

I have a number of exhibits that rely on NiCad rechargeable batteries. Consequently, each manufacturer prescribes a different preferred schedule for recharging the battery, which I have followed (recharge as little as possible vs. keep at maximum charge, charge no longer than seven hours vs. always keep charged).

Is there any generally preferred schedule, or should every battery be treated per its instructions?

129811 **Thomas Ng**
San Jose, CA

I recently acquired an RCA CCTV camera model TC101 and monitor model TC1112. The system worked fine until the monitor failed.

I am seeking the following information: **1.** What type of adapter to buy or build so the camera can be used with a standard TV monitor (there is a sync conflict)? **2.** A service manual or schematic of the original monitor.

129812 **Joe Pitman**
via Internet

A while back, I remember reading either an article or a reader's comment in *Nuts & Volts* about those stripes that are in the new money. Can anyone with the proper scanner "scan" you or your house to see how much money you have?

129813 **Dave Mikesch**
via Internet

I am looking for two schematics that are relatively simple, but currently beyond my ability to manufacture.

1. A circuit that would power a very loud sonalart-type device (regularly timed pulses versus a continuous tone) that I could mount in my model airplanes so I have an audible tracking aid when and if I lose another one.

2. A simple timer that would activate with one SPDT switch that would beep once at one minute from the time it was started, twice at two minutes, and so on up until about 20 minutes or so.

If someone could tell me where to find such a circuit. I can build it, I just can't design it.

129814 **Tom**
via Internet

I am trying to interface various sensors/transducers to the serial/parallel ports of my IBM-clone.

A major improvement would result if I could (temporarily) modify the system-boards 8253 timer IC, so as to generate interrupts every 0.1 milliseconds, instead of the standard 55 millisecond limit.

Can this be done at all? I know "C" fairly well, but when I tried output b() to the 8253 (assuming the control register is at addresses 0x043 and the third counter is at 0x42),

ANSWER INFO

- Include the question number that appears directly below the question you are responding to.
- Payment of \$25.00 will be sent if your answer is printed.
- In most cases, only one answer per question will be printed.
- Your name, city, state, and E-Mail address, (if submitted by E-Mail), will be printed in the magazine, unless you notify us otherwise with your submission.
- Due to space limitations, we can not reprint the original questions with the answer. The question number and the issue it appeared in are printed above the answer.
- Unanswered questions from a past issue may still be responded to.
- Comments regarding answers printed in this column may be printed in the Reader Feedback section if space allows.

QUESTION INFO

TO BE CONSIDERED FOR PUBLICATION

All questions should relate to one or more of the following:

- 1) Circuit Design
- 2) Electronic Theory
- 3) Problem Solving
- 4) Other Similar Topics

INFORMATION/RESTRICTIONS

- No questions will be accepted that offer equipment for sale or equipment wanted to buy.
- Selected questions will be printed one time on a space available basis.
- Questions may be subject to editing.

HELPFUL HINTS

- Be brief but include all pertinent information. If no one knows what you're asking, you won't get any response (and we probably won't print it either).
- Write legibly (or type). If we can't read it, we'll throw it away.
- Include your Name, Address and Phone Number. Only your name will be published with the question, but we may need to contact you.

nothing happened. Any suggestions?

129815 **Thomas Ng**
San Jose, CA

Does anyone know how to build a code scanner for Mitsubishi cars? The scanners for other makers are available now.

129816 **Yan Wu**
Boston, MA

I have a couple of data loggers which record a 0-5V DC signal, at 20 samples per second. Unfortunately, the sensors I would like to use with

TECH FORUM

these data loggers produce various outputs, [i.e., 0-50MV DC, 0-500MV DC and 0-1V DC.

I would like to construct or purchase ready made, what I believe would be called a linear DC amplifier with the inputs mentioned above and a 0-5V DC output that I could connect to my data logger. Can anyone help me?

129817 **Peter Marsh**
via Internet

I have a piece of test equipment that has the GPIB interface. I want to use the GPIB to download data from that equipment to my PC. Can I accomplish this with a bi-directional parallel port, or do I have to shell out \$400.00+ for a GPIB board? I am capable of writing the driver myself, but if this were possible someone must have done it. Any input?

129818 **Bill Eaton**
Hamilton, OH

I enjoy reading and building projects in the *Nuts and Volts* magazine. I especially like the articles involving the BASIC Stamp and general articles on using serial and parallel ports to control projects.

I have read articles in the past to change a SVGA monitor to a RGB, but I don't know if the reverse is also possible.

I have a digital 19" monitor model #VR 299-DA manufactured in June 1990. The monitor has three BNC connectors (RGB) on the back. Other information Hz: 50-60, W: 150, V: ~100-120, A: 2.2.

I was interested in hooking the monitor up to my computer SVGA output. Is this possible? What will it take?

129819 **Matt Droter**
via Internet

Apple II emulators for the IBM PC require that images of the Apple diskettes be stored on the PC. I would like to build a hardware/software interface that would allow me to create these images by directly reading an Apple floppy drive connected to a PC via the parallel port or expansion bus.

Does anyone have details on how this could be done? Are there any detailed hardware manuals available for the Apple drive that would help me develop my own interface?

129820 **John Reynolds**
via Internet

I have an old drawing program called DR HALO. I used it for drawing circuits and such. I would like to convert these drawings I saved in DR HALO format (PIC), to the new standard of BMP, PCX, TIF. I have been hunting for a conversion program for five years now.

The program CSHOW ver 8.76a will recognize the PIC format, but I can only view the drawings.

Does anyone know of a conversion program for this type of format and where I could get it?

129821 **Terry Baker**
St. Paul, MN

I have an OPTREX DMF-633 display that I would like to interface with. I would like to know if there are any circuit examples of using an EPSON SED1330 or SED1335 controller with this display.

129822 **Anonymous**

I have an old 486 motherboard that I would like to use in a robot. When the robot is running, I would like to unhook the keyboard and monitor. How can I bypass the keyboard and monitor? I have looked through the bios, and there is no way to turn it off.

129823 **Brent Lamb**
Lubbock, TX

I read Karl Lunt's March and April '98 articles on hacking the GameBoy.

I tried looking on Jeff Frohwein's web page and his links, but I can't find something.

Do you know where I can get info on hacking the GameBoy Camera? I want to use it for very crude object recognition — with or without interfacing to the GameBoy.

Any schematics, pinouts, or code related to the GameBoy camera would be really helpful.

129824 **Jim Awrach**

ANSWERS

ANSWER TO #10985 - OCT. 1998

In response to Robert Ritchey's question on the jumper settings for his Magitronics Motherboard. He can contact the company by writing: **Magitronic Technology, Inc.**, 6585 Crescent Dr., Norcross, GA 30071; **1-800-4-LIUSKI**. They are the parent company to Magitronics.

They also have web sites which E-Mail inquiries can be made, as well as information and files on their products can be obtained.

I checked the site and the product Robert has, it is outdated and not supported on their web page. But they do state that if you contact them on older motherboards and give the information he gave in his question, they would fax or mail the information on the motherboard jumpers if they still have it available. Their web page is <http://www.magitronic.com> or <http://www.liuski.com>.

Wesley K. Miller
Camp Hill, PA

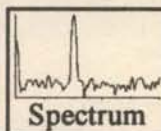
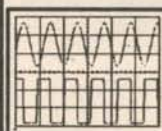
ANSWER TO #10987 - OCT. 1998

The 8909-02A microprocessor reads the push buttons and signals from the remote control and programs the TV accordingly.

Digital Storage Oscilloscopes

From \$189?

ATC modules connect to your PC printer port and transform it into a full-function DSO, spectrum analyzer, logger, & DVM. Units DC to 25MHz



Captured Waveforms
Pico Tech
ADC-200 in
Windows

O-Scope II
in DOS



ATC proudly announces the addition of Pico Technology Ltd. products to our product line. Pico is based in Britain and offers a variety of data logging and virtual instrument modules.

O-Scope Ip (ST 50KHz).....\$189

O-Scope II (DT 500KHz).....\$349

ADC-100 (DT 12bit 50KHz)..... \$449

ADC-200/20 (DT 10MHz).....

ADC-200/50 (DT 25MHz).....

CALL

Loggers 1-22 ch. (8-16 bit) from \$99

Shipping UPS \$7.50 grnd, \$11.50 (2 day)



800-980-9806

Allison Technology Corporation

2006 Finney Valley Rd., Rosenberg, TX 77471

Fax: 281-239-8006 Technical: 281-239-8500

E-Mail: atc@accesscomm.net

<http://www.atcweb.com>

This IC is found in Goldstar Chassis NC-91A and is available from: **Shine Electronics**, 11-22 45th Rd., Long Island City, NY 11121; **1-800-243-0000**.

This identical chassis family is used in the J.C. Penney model 2193 (685-2193; Catalog No. 855-9007) and the IC is available from: **Cititronix**, 1641 Dielman Rd., St. Louis, MO 63132-1597; or **Panson Electronics**, 1-80 & New Maple Ave., P.O. Box 2003, Pine Brook, NJ 07058; **1-800-846-2484**.

Before you call have the part designator from the PC Board (IC1 in both of the above chassis, but check yours to be sure) and the model number and serial number of your set. These microprocessors have internal ROM and the code is sometimes modified over the life of the product. The microprocessor from an earlier serial number might not work in a later one.

Expect to pay \$25-\$30 including shipping.

Bob Miller
Trenton, NJ

ANSWER TO #10988 - OCT. 1998

Yes, there is a memory expansion board available for the LaserJet HP II.

There are two types of memory expansion cards, 4 meg and 2 meg that you will have to populate with memory chips. (The 2 meg HP cards can be connected together to make

4 megs. Note: The maximum amount of memory that the HP II will recognize is only 4608K bytes.)

I have found lots of dead laser printers at my local electronics surplus stores, and have been buying them for parts machines.

Unfortunately, I don't have any memory boards left right now. But here are a few places that sell laser printer parts: **Laser Products Co.**, 1534 Burlington Ave., Kansas City, MO 64116; phone: **1-800-786-8897**, fax **816-471-1677**. **GOLD-SMITH GROUP**, Indianapolis, IN; phone: **1-800-989-7295**, fax **317-545-4883**; E-Mail: recycle@iquest.net, website: www.goldsmithgroup.com

Terry Baker
St. Paul, MN

ANSWER TO #11984 - NOV. 1998

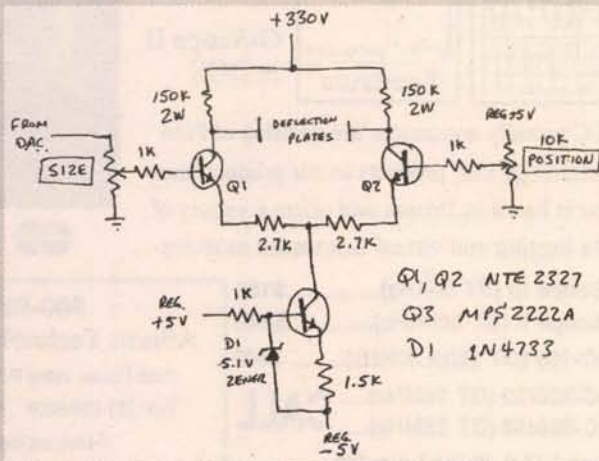
There is no way to prevent duplication of your audio cassette tape, using an electronic gadget or otherwise. In fact, at this point in time, it's easy to dub analog audio cassette tapes, DAT (digital audio tapes), digital mini-discs, and even audio CDs, and also to copy from one format to another.

If your tape can be played back in a standard cassette player, then it's possible to patch the audio from the player into a second deck and make a dub of your original tape. Even if you record the tape at a non-standard speed, requiring the end user to

ANSWERS TO #11985 - NOV. 1998

The 3UP1 is a three-inch CRT with electrostatic deflection. There are two pairs of deflection plates, one for horizontal and one for vertical. The included schematic is for a simple deflection amplifier to drive the plates. You will need two such circuits, one for vertical plates and one for horizontal plates. I am presently using this circuit with a 3RP1 CRT, which has similar electrical characteristics.

The circuit is based on a classic differential amplifier. Q3 forces the sum of the currents through Q1 and Q2 to be constant at 3 milliamperes. The voltage difference between the Q1 and Q2 collectors (applied to the plates) is a function of the difference between the Q1/Q2 base voltages. One base gets the signal input (from the 0-5V DAC output in your case), while the other gets a DC voltage (about 2.5 volts) that positions the undeflected spot in the center of the CRT face. The signal input must be DC-referenced



to circuit ground.

If the 3UP1 deflection plate capacitance is indeed 20 picofarads, the effective bandwidth of this amplifier/CRT combination should be at least 50 KHz. My guess is that actual capacitance is lower, so bandwidth will be greater.

For even more bandwidth, you could decrease the emitter/collector resistor values and increase the circuit current.

If you cannot obtain sufficient deflection range with this circuit, try increasing the +330V DC supply, making sure that Q1/Q2 have adequate VCC rating.

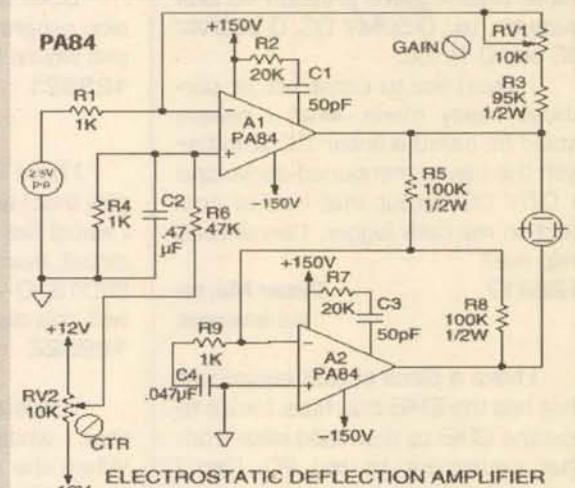
Joe Moell
Fullerton, CA

ANSWERS TO #11985 - NOV. 1998

Design of a high-voltage deflection drive amplifier with 3 MHz bandwidth is no trivial task. However, there is a device made by Apex Microtechnology that was actually designed for your application.

I am assuming that your CRT uses static deflection because of the low (20 pF) capacitance you quoted. The circuit in the schematic is taken directly from their application notes and uses two PA84 high-voltage power op amps in a bridge configuration. This allows you to use a $\pm 150V$ power supply to get a $\pm 300V$ output swing.

You could hook a bipolar DAC output directly into the input of the amplifier. A unipolar DAC would require



some OV level shifting. A free data book for Apex Microtechnology devices is available at 1-800-546-2739. If you have Internet access their URL is: <http://www.apexmicrotech.com>

Kevin Goodwin
Oceanside, CA

obtain a non-standard player from you, the tape could be duplicated two ways: By connecting the audio output from the special player to the input of a standard recorder, or by playing it on a readily-available variable-speed player.

Consider this drastic — but unrealistic — solution: You load the original non-standard tape on the non-standard player, and weld the player into a steelplate box, with only the controls and speaker accessible, with explosives enclosed to prevent opening the box.

Now, your customer can play the tape, but can't get it out for duplication.

Even so, it would be possible to make a fairly good recording from the loudspeaker in your special play-

er, by using a high-quality microphone, and probably some audio filtering (to compensate for the frequency response of the player's speaker).

So, unless the audio quality needs to be exceptionally good (maybe very high-fidelity music, for example — but audio cassettes aren't capable of high audio quality), someone could make a usable duplicate.

Unauthorized copying is a sore point with the music industry. They lobbied to have circuitry put into DAT decks that prevented making multiple direct-digital copies of digital originals. (This process kept DAT decks off the US market for so long that it effectively killed the demand for them.)

Even so, you can easily connect

the analog (audio) output from one DAT deck to the analog input of a second DAT deck, and make all the copies you want.

Depending on how much revenue you stand to lose from unauthorized duplication, you might consider the possibility of copyrighting your material, and prosecuting for any unauthorized duplicates that you discover. I fear though, that you will find this solution fairly impractical.

Greg Miller
State College, PA

ANSWER TO #11986 - NOV. 1998

Many GWBASIC programs (if saved in ASCII format with option A) will run on QBASIC "as-is" complete with line numbers. This is certainly true if your QB version was derived by simply deleting the line numbers from the GWBASIC program. In other words, all of the statements and functions (OPEN, COM, INPUT\$, etc.) appearing in your QB version function the same way in both

GWBASIC and QBASIC.

How can I make such a claim? By testing your QB version as follows:

First, I connected the COM1: serial ports of my host and remote computers with a null modem cable. Then I wrote, loaded, and ran the following multimeter surrogate program on my remote computer.

```
10 OPEN "COM1:1200,N,7,2,RS,
   CS,DS,CD" FOR RANDOM AS #2
20 IN$ = INPUT$(1, #2)
30 IF IN$ <> "D" THEN 20
40 PRINT IN$
50 PRINT #2, "-12.34 volt DC"
60 CLOSE #2
```

Next, I loaded and ran (on QBASIC) your QB version on my host computer. The character D was displayed by my remote computer; the string -12.34 Volt DC was displayed by my host computer, thus verifying the fundamental integrity of both programs.

After I added line numbers to

Continued on page 64

EZ-EP DEVICE PROGRAMMER - \$169.95

Check Web!! -- www.m2l.com

Fast - Programs 27C010 in 23 seconds

Portable - Connects to PC Parallel Port

Versatile - Programs 2716-080 plus EE and flash (28, 29) to 32 pins

Inexpensive - Best for less than \$200

• Correct implementation of manufacturer specified algorithms for fast, reliable programming.

• Easy to use menu based software has binary editor, read, verify, copy, etc. Free updates via bbs or web.

• Full over current detection on all device power supplies protects against bad chips and reverse insertion.

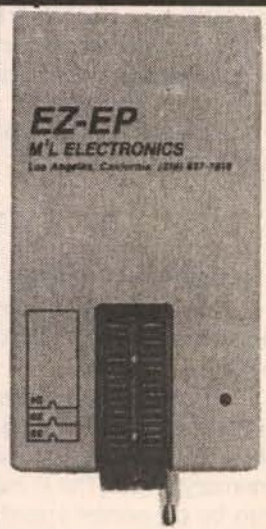
• Broad support for additional devices using adapters listed below.

Available Adapters

EP-PIC (18C5x, 81, 82x, 71, 84) \$49.95
EP-PIC64 (16C62-5, 72-4) \$39.95
EP-PIC12 (12C50x) \$39.95
EP-PIC17 (17C4x) \$49.95
EP-51 (8751, C51) \$39.95
EP-11E (68HC11 E/A) \$59.95
EP-11D (68HC11D3) \$39.95
EP-16 (16bit EPROMs) \$49.95
EP-28 (286E02, 3, 4, 6, 7, 8) \$39.95
EP-SEE2 (93x24x, 25x, 85x) \$39.95
EP-750 (87C750, 1, 2) \$59.95
EP-PEEL (IC22v10, 18v6) \$59.95
EP-1051 (89C1051, 2051) \$39.95
EP-PLCC (PLCC EPROMs) \$49.95
EP-SOIC (SOIC EPROMs) \$49.95
EP-TSOP (TSOP EPROMs) \$59.95
Many Other Adapters Available

M2L Electronics

970/259-0555
Fax: 970/259-0777
361 S Camino Del Rio #119
Durango, CO 81301
CO orders please add 7% sales tax.
<http://www.m2l.com>



A & S WHOLESALE Cable Boxes • Accessories

DEALERS ONLY

	5 LOT	10 LOT
PANASONIC w/volume	\$160	\$145
DIGI w/volume (125 ch.)	\$165	\$150
DIGI one-piece (83 ch.)	\$105	\$99
PANASONIC 1003	\$55	\$49

CALL FOR PRICING ON ITEMS NOT LISTED
Buy Directly From The Wholesaler And Save \$

1-800-370-0801

Mon. - Fri. 9am - 6pm • CST

30-Day Money Back Guarantee • 6 Month Warranty

Anyone implying theft of cable service will be denied assistance.

WE WILL MEET OR BEAT OUR COMPETITOR'S PRICING

HAM GEAR FOR SALE

WANTED: ROCKWELL-Collins HF-80 equipment, 851S-1, 237B-3 log periodic, Collins literature. Jim Stitzinger 805-259-2011, 805-259-3830 (fax), bfi-jfs@smartlink.net

HAM EQUIPMENT repair or overhaul Collins, Drake, Swan, Astro, Yaesu, Kenwood, etc. 20 years experience with former Slep Electronics Co. Same excellent service, same reasonable rates, satisfaction guaranteed. Brooks Electronics, 828-349-3503. E-Mail: rwbrooks@dnnet.net

TELETYPE MACHINES. 12 Telex model 32, 1 Telex model 35, 2 Telex model 28, 1 Siemens T100, 1 Telex model 8000, 2 Telex model 1000. Most in working condition. Best offer for the whole works, as-is, where is. Revelstoke BC. Telephone 250-837-2081.



MIKEMASTER: A microphone preamplifier with noise gating & compression. Created by Marv Gonsior W6FR, March 1998 QST. Got noise get MikeMaster! For kit order #210-KIT at \$69.95. Assembled & tested (specify Kenwood, ICOM, or Yaesu wiring) order #210-ASY at \$89.95. Shipping for US & Canada is \$6.50, others add 15%. CA residents add 7.75% sales tax. For info send legal size SASE to A&A Engineering, 2521 W. LaPalma #K, Anaheim, CA 92801. P 714-952-2114, Fax 714-952-3280.

MILITARY COMPONENTS wanted. Capacitors, resistors, diodes, transistors, semiconductors, ICs. Electronic Material Industries, 818-769-1002, FAX: 818-769-1084.



THE SMART BATTERY CHARGER for lead acid or gel cell batteries. Can be left connected to the battery INDEFINITELY, will not overcharge! Standard kit is 12V @ 1 amp. This kit is 100% complete. For the kit order #150-KIT at \$59.95. For an assembled and tested unit, order #150-ASY at \$79.95. CA residents add 7.75% sales tax. Add \$6.50 per unit shipping. MC/VISA accepted. A&A Engineering, 2521 W. La Palma #K, Anaheim, CA 92801. 714-952-2114, FAX 714-952-3280.

LML RADIO 2 meter mobile amp by Motorola 60 watt \$30; Motorola Mostar VHF 16 ch. prg. 45W \$30; MT500 50MHz \$35; Syntor VHF 45W prg. UHF repeater 15W programmable 256 channels \$120. Free catalog 909-873-1319. Fax on demand 24 hr. 909-820-1885. Web catalog. <http://members.aol.com/hrh6/LMLinc> Write 424 E. Shamrock, Rialto, CA 92376.

POWER SUPPLIES Pyramid, simply the best durable power supply on the market for value! Ideal for radio use, amps, or bench work. 13.8 VDC from 3 amps to 52 amps available with surge protection. Some models available with cigarette plug socket. Factory packed in retail display boxes. All come factory new with one year warranty. Lowest prices on any quantity. Wholesale/distributors welcome. Gentry Communications 507-332-2788.

SPECTRUM ANALYZERS, test equipment. Closing R&D/manufacturing company. Must sell lots of equipment. Call 1-800-869-7827 or visit www.starcom.com

NEW PRODUCTS FROM S & S: UPGRADE YOUR OLD RIGS! Digital dial (counter) has 10Hz resolution HF, 100Hz VHF and frequency range 50KHz to 230MHz; kit \$99.95; assembled \$149.95. **NEW Digital VFO** with 1Hz resolution to 54MHz; kit \$169.95; assembled \$219.95. S&H \$7 (Continental US). **GUARANTEED TO WORK.** For info send SASE. Call/write to order: S & S Engineering, 14102 Brown Rd., Smithsburg, MD 21783. 301-416-0661, E-Mail: N3SAD@aol.com or see <http://www.xmetric.com/sseng>

HAM GEAR WANTED

MILITARY COMPONENTS wanted. Capacitors, resistors, diodes, transistors, semiconductors, ICs. Electronic Material Industries, 818-769-1002, FAX: 818-769-1084.

CB - SCANNERS

SALES, SERVICE: CB equipment, radios, modifications, power mice, echo-reverb boxes, kits, meters, filters, antennas, noise toys, mounts, hard-to-find items. Partial list \$1, complete list \$4. D&R Electronics, 10 Park St., Thomaston, CT 06787. 860-283-9492.

RED BOOK CB MODIFICATION. Audio, modulation, PLL/VCO, sliders, \$25. Ken's 2825 Lake, Kalamazoo, MI 49001. 616-345-4609. www.kenselecronics.com

BLACK BOOK CB LINEARS. Theory, 60 schematics. \$25. KEN's, 2825 Lake, Kalamazoo, MI 49001 616-345-4609. www.kenselectronics.com



ULTIMATE MODIFICATION BIBLE. Mind boggling is the only way to describe this 220 page book. Modification of CBs, channels, power, sliders, talk back and more. 10 meter radios, HAM RADIO, scanners, toys, meters, and more. Only \$29.95 + \$3.25 shipping. Phone orders 1-800-256-9895 (MC-Disc-Visa) No CODs.

ORANGE BOOK SCANNER REPAIR. 500 models, modifications, \$25. KEN's, 2825 Lake, Kalamazoo, MI 49001 616-345-4609. www.kenselectronics.com

SCANNING USA: monthly magazine 100% scanning. All the news and product reviews from the writers you trust. Get more from your scanner. Subscriptions \$24.95, samples \$3. Call 1-800-651-0922 your Visa or MasterCard, or write 2054 Hawthorne, Joliet, IL 60435

"CB MODIFICATION SECRETS," new 200-page guide by author of "CB Radio Hacker's Guide." More easy AM/SSB CB upgrades & enhancements: Cobra, Realistic, Uniden, President, etc. Freq. expansion, VFO, clarifier unlock, VOX, Roger Beep, anti-theft device, receive preamp, more. Only \$21.95, plus \$5 S/H (\$7 to Canada). CRB Research, Box 56, Commack, NY 11725. NYS res. add \$2.22 tax. Visa/MC orders call: 516-543-9169.

MICRO VIDEO CAMERAS

MB-750U & MB750P
Video Cameras
your Choice
\$89.95

- 1.25" sq.
- .1 LUX
- 420 TV Line

The Best, Smallest, Micro Cameras on the Market Today!
Call and Compare! We Match or Beat All Prices!

WIRELESS VIDEO CAMERAS

NIGHT VISION



GFT-1001



Compatible with
AC or Battery

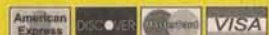


Transmits
Over
1000 ft.



Wireless Observation System's
GFS-1001 (900MHz) - \$499.95
GFS-1001c (900MHz) - \$599.95
(1.2 Ghz system available)

Wireless 4-Channel B/W &
COLOR Cameras Available!
Plug and Play Readiness



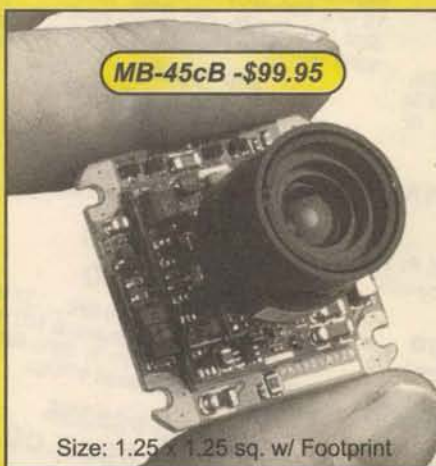
1-800-752-3571

Visit Polaris Ind. Web Site at:
<http://www.polarisusa.com>

Polaris Industries 470 Armour Drive NE • Atlanta GA 30324 • Tech Info: 404-872-0722 • FAX 404-872-1038

Panasonic Color Camera Sale

MB-950c Panasonic Camera Sale \$99.95 was \$299.95
Sale Ends 12/31/98



Micro Color MB-45cB: \$99.95

- Wide Voltage Range, 5-14 Volts!
- Small Footprint!
- Self contained ultra small package design for various applications.
- MCM PCB design for minimizing the size and improve durability.

Specifications: MB-45cB Color Camera

Pick-up device	1/4" Interline transfer
Effective Pixels	512 (H) x 496 (V)
Scanning System	2:1 Interlace
	525 lines - 60 fields
Frame per second	30 frames
Synchronization	Internal
Video output	VBS. 1vpp 75 Ohms
Horizontal Res.	More than 330 lines
Min. Required Illumination	40 LUX @ F2.8
AGC	On fixed
White Balance	ATW fixed
Operating Temperature	32°F to 104°F
Ambient conditions	Indoors
Lens	F2.8 Hor. Angle 45° - Ver. Angle 34°

AFFORDABLE LIPSTICK CAMERAS

These cameras are supplied with a PCM-1 Video/Power cable.
The BNC connection is for standard video connection to a Monitor or VCR.



Prices, availability and specifications are subject to change without notice. Shipping and Handling are not included with price.

CB RADIO EQUIPMENT: Selling all kinds of equipment! For details E-Mail: rushead1@juno.com

CB MODIFICATIONS! Frequencies, books, kits, high-performance accessories, plans, repairs, amplifiers, 10-meter conversions. The best since 1976! Catalog \$3. CBCI, Box 1898NV, Monterey, CA 93942. www.cbintl.com

240+ CHANNEL CB/HAM/COMMERCIAL radios: AM/FM/SSB/CW export/domestic: RCI, Motorola, Uniden, Cobra, Alinco, Kenwood. Mics, antennas, linears, meters, books, night scopes, and tons more stuff! Catalog \$3. MAXTECH, Box 8086, New York, NY 10150. 718-547-8244.

KONNEX DISTRIBUTING. Call 1-888-777-7874. PO Box 451372, Los Angeles, CA 90045. CBs, antennas, meters, transistors. Best prices. Credit card acceptable.

ANTTRON 101 CB 10 METER base station antenna with isolation network, no bleedover, no splatter, no TVI tuning sleeve technology 3 piece fiberglass \$69.99. **Twin-Tronics, Inc.** PO Box 2571, Youngstown, OH 44507-0571. Send \$1 for literature, refundable. Ph 330-788-9693. Fax 330-788-7709.

ROGER BEEP noise toys with instructions. Send \$18 each postage paid to: TINKERTRONICS, PO Box 270786, Corpus Christi, TX 78427.

SUPERSTAR, GALAXY, Mirage, Uniden, Cobra, microphones, power supplies, scanners hard-to-find products, picture price sheets. \$1 to cover postage (REFUNDABLE). Galaxy, Box 1202, Akron, OH 44309. Over 10 yrs. in business.

MUSIC & ACCESSORIES

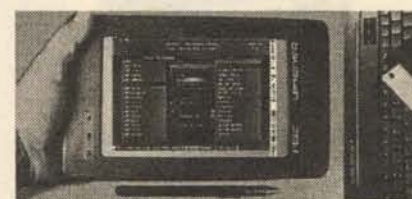
Subscribe to Nuts & Volts Today!
Call 1-800-783-4624
and Use Your Visa or MasterCard.

COMPUTER HARDWARE

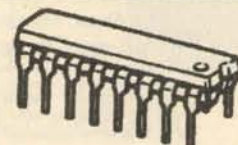
START YOUR OWN TECHNICAL VENTURE! Don Lancaster's newly updated **INCREDIBLE SECRET MONEY MACHINE II** tells how. We now have autographed copies of the Guru's under-ground classic for \$18.50. Synergetics Press, Box 809-K, Thatcher, AZ 85552. 520-428-4073. VISA/MC.

WE CARRY a variety of cables, switch boxes, accessories, and adapters to connect PCs, printers, Mac's, networks, telecommunications, and audio/video equipment. We offer: custom cables, free catalogs, and same day shipping on most orders. Visit our website at www.rogerssystems.com or call 1-800-366-0579.

CRTs CHEAP. Buy direct from the manufacturer. Save money. Mfg. all CRT types since 1950. **3 year warranty.** Reg-Res 19" tubes \$75; 25" \$100; hi-res 13" tubes from \$80. We specialize in **hi-resolution** video/computer CRTs. T.M.C. 215-226-0749/215-223-0388.



THE SMALLEST AND COOLEST, FULL IBM PC EVER MADE! Yours for \$649! Cost was \$4,000. People are amazed when they see it! Extremely well made. Weighs only 2 pounds! Measures 9"x5.5"x1.37"! Take it wherever you go! Runs any application for DOS or Windows 3.1. Windows for pen computing has animated icons & sound annotation with a cool female personality. Only a few available, so don't wait a single day. Built-in handwriting recognition and on-screen or external keyboard. Electronic pen acts as a mouse and doesn't need to touch the glass screen to move the cursor! 486/25 with 4 meg RAM and 80 megabyte capacity. Razor sharp 6" mono screen, 640x480/1 meg VGA touch screen, built-in speaker, parallel/serial/ext. monitor, outputs. Includes: electronic pen, battery, glove leather case, AC supply, compact external keyboard is the same size as the computer. Small external half inch high 1.4 floppy. Books and software. Netcom 1-800-733-3733 ext. 6300.



WANTED: EXCESS ELECTRONIC INVENTORIES, ICs, MEMORY, EPROMs, PALs, LEDs, CIRCUIT BOARDS, DIODES, AND TRANSISTORS. CALL ACTIVE MICRO, 435-867-8660 OR FAX 435-867-8663.

<http://www.pccables.com> PC CABLES and PARTS. 100s of hard-to-find new cables and parts, free technical information, low prices, fast online ordering & browsing.

COLOR LASER PRINTERS: Hewlett Packard Color Laserjet (3100A) \$1,490; QMS Colorscript 210 (postscript) \$995; QMS Colorscript 230 (postscript) \$1,395; QMS Magicolor CS1000 (11x17") \$1,695; Tektronix Phaser (4693PX) \$595; Tektronix Phaser 200i (postscript) \$895; Tektronix Phaser III PXL (11x17") \$995; Tektronix Phaser 300i (11x17") \$1,695. Accept VISA, MasterCard, AMEX. 60 day warranty. Call MAPLE DATA: 908-964-7070. E-Mail: Maplesales@aol.com

Quality Reconditioned TEST EQUIPMENT

Advantest R3271 \$19,000.00

Spectrum Analyzer, 100 Hz to 26.5 GHz excellent spectral purity, 10 Hz to 3 MHz resolution bw, built-in frequency counter with 1 Hz resolution.

Anritsu MG 3670B \$17,500.00

Signal Generator, 300 kHz to 2.25 GHz, -143 to +13 dBm (resolution 0.1 dB). Digital modulation signal generator equipped with high quadrature modulator. Has MG0303B burst function.

Anritsu MG 3671B \$19,500.00

Digital Modulation Signal Generator, 300 kHz to 2.7 GHz, -143 to +13 dBm (resolution 0.1 dB). Provides a stable and precise output as well as spectral purity up to a max output of +13 dBm, even with modulation.

Hewlett-Packard 8657A \$3,900.00

Signal Generator, 100 kHz to 1040 MHz, 10 Hz resolution, output power +13 to -143.5 dBm into 50Ω. Option 002, RF connectors on rear panel.

Hewlett-Packard 3561A \$8,250.00

Dynamic Signal Analyzer, .000125 Hz to 100 kHz, +27 to -120 dBV, 80 dB dynamic range, to 640 μHz resolution bw.
3561A Opt 001 \$8,750.00
(extended non-volatile memory)

Hewlett-Packard 8566B \$39,500.00

Spectrum Analyzer, 100 Hz to 325 GHz with external mixers (not provided), amplitude range of -134 to +30 dBm.

Hewlett-Packard 5342A Special \$1,350.00

Microwave Frequency Counter, 500 MHz to 18.0 GHz, wide FM tolerance, 11 digit led display, sensitivity to -25 dBm. Opt 001, high stability time base; 011, HP-IB.

Hewlett-Packard 3562A \$10,700.00

Dynamic Signal Analyzer, 64 μHz to 100 kHz, spectrum, network and transient analysis, 150 dB dynamic range, high accuracy.

Hewlett-Packard 3563A \$14,000.00

Control Systems Analyzer, provides measurement of analog and digital signals. Network, spectrum, waveform and transient applications. 64 μHz to 100 kHz, 80 dB dynamic range, analog and digital input, high accuracy (+/-0.15 dB).

Hewlett-Packard 8671A \$4,250.00

Microwave Frequency Synthesizer, 2.0 to 6.2 GHz, +8 dBm min. output power.

EIP 545 Special \$750.00

Microwave Frequency Counter, 10 Hz to 18 GHz frequency range (3 bands), 12 digit LED display, time base: 10 MHz, aging rate <3x10⁻⁷/month, 50Ω input.

EIP 545A Special \$895.00

Microwave Frequency Counter, 10 MHz to 18 GHz frequency range (3 bands), 12 digit LED display, time base: 10 MHz, aging rate <3x10⁻⁷/month, 50Ω input.

Wavetek 3520 \$2,500.00

Signal Generator, 1 to 2800 MHz, -137 to +10 dBm, frequency resolution is 100 Hz to 1040 MHz and 200 Hz to 2800 MHz, GPIB, 32 front panel stored settings.

Avcom PSA35A Special \$995.00

Portable Spectrum Analyzer, low bands 10 MHz to 1750 MHz; high bands 3.7 to 4.2 GHz. 60 dB dynamic range.

Electro Metrics ESA1000 Special \$1750.00

Spectrum Analyzer, 100 kHz to 1000 MHz, has CISPR IF BW and quasi peak. Has DM1000 digital memory option.

Hewlett-Packard 5335A Special \$695.00

200 MHz Universal Counter, built-in automatic risetime, duty cycle & pulse width.

Hewlett-Packard 3312A Special \$575.00

Function Generator, 0.1 Hz to 13 MHz in 8 decade ranges, AM/FM, sweep, trigger, gate and burst.

Hewlett-Packard 54603B New \$1395.00

60 MHz Oscilloscope, 2 channel, 2mV to 5V/div sensitivity, 20MSa/s sample rate.

Tektronix 2213A Special \$600.00

60 MHz Oscilloscope, 2mV sensitivity, 5 nS/div sweep speed, advanced trigger system. Includes 2 probes.

Tektronix 2220 Special \$895.00

60 MHz Oscilloscope, digitizing rates 20 MS/s at 5 us/div and faster to 20 samples/s at 5 s/div, digital storage/non-storage, single timebase, 4 k record length.

Tektronix 2430A Special \$3,750.00

150 MHz Digital Oscilloscope, 100 MS/s digitizing rate, simultaneous acquisition on 2 channels, envelope mode with 2 ns glitch capture. Has Opt. 05, TV/Video waveform measurement; 11, probe power.

Tektronix 466 Special \$575.00

100 MHz Storage Oscilloscope, dual trace, 5 mV/div, stored writing speed of 3000 div/μs variable persistence. Includes 2 probes.

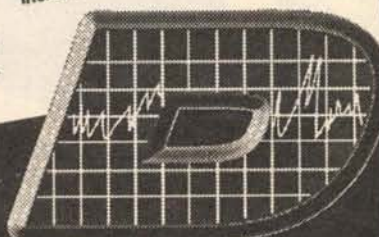
Tektronix 465 Special \$550.00

100 MHz Oscilloscope, dual trace, 5 mV/div sensitivity, 5 nS/div sweep rate. Includes 2 probes.

**WANTED
USED TEST
EQUIPMENT**

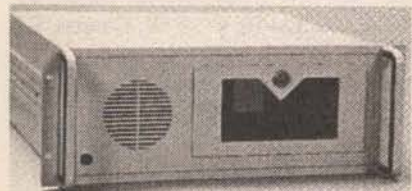
(602) 483-6202
Fax (602) 483-6403

14455 North 79th Street, Unit #C • Scottsdale, Arizona 85260



**DANBAR
SALES COMPANY**

PENTIUM MOTHERBOARDS, VIA chipset, 1MB, AGP, 100MHz operation, 3 ISA/3 PCI, \$95. **CPUs:** Celeron 128K 300/333 @ \$169/179. Pentium II: 300/333/350/400/450 @ \$239/259/279/419/599; **IBM/Cyrix** 233/266/300/333 @ \$66/78/99/149; **AMD K6 MMX** with 3D Now 266/300/333/350 @ 109/119/129/169. 36X **CD-ROM**, audio button \$44, 32/64MB SDRAM 10ns DIMM \$49/99, 64/128MB PC-100 DIMM \$101/199. S3 Trio 3D 4MB AGP video card \$34. Call for current pricing, other parts and illustrated catalog, faxback catalog pages, 1-year warranty or better. tech-specialties, Inc., 5703 Heffernan, Houston, TX 77087-4113, 1-800-864-5391 for orders and tech support, fax: 713-307-0314, Internet: www.ts.nu



19" RACKMOUNT PC chassis: Heavy duty, 4U, for standard 7 slots ATX motherboard. Optional 8, 12, 14 slots back panels available. Four (three hidden) 3.5"/two 5.25" drive bays, 4.625" front panel fan, power supply not included, \$189 with this add Monitor chassis \$269, keyboard chassis \$139. 8255-8253 I/O card with prototyping area \$69, 12-bit ADDA card \$89. **Computronics Technology**, 972-242-8087.

SYSTEMS, PERIPHERALS. UPS. Closing R&D/manufacturing company. Must sell lots of equipment. Call for list 1-800-869-7827 or visit www.starcom.com for list



MONITORS R US®, COLOR \$54 & UP, used, low milage, refurbished, run in 5 hrs. & calibrated. Excellent image, 90 day warranty. Satisfaction guaranteed. (1) 14" VGA .28DP, analog controls \$49 ea. Your choice Phillips-Magnavox, Teco, Hyundai, CTX & Unisys brands. (2) 14" VGA .26DP digital controls \$69 ea. Maker Zenith Data Systems. (3) ERGO MONITOR ARM SET, NEW IN FACTORY SEALED CARTON NOW \$59 ea., includes MA-2 arm, CM desktop clamp and monitor tray. (4) NEC-AST VERSA, Laptop Docking Station Series 2, \$49 each. New in factory sealed carton. (5) MICRO FERRUPS MODEL ME-3.1 KVA, MAKE OFFER. Shipping weight about 200 lbs. NOTE: all prices each, FOB Las Vegas. UPS shipping weight 14" monitors 30 lbs., monitor arm set 36 lbs. & docking station 28 lbs. Mail orders: **LESS BUSTERS ELECTRONICS**, 2039 CIVIC CENTER DRIVE #176, N. LAS VEGAS, NV 89030, 702-642-0325. **WEB** www.lessbusters.com

BUILD YOUR own PENTIUM COMPUTER from parts with the help of an easy to view 80 min video tape. This award winning VHS tape shows how to save money or even start a small business by assembling any IBM compatible 386 to Pentium II computer in a step-by-step, easy-to-follow procedure. Don't let this opportunity pass you by! Order today, while supplies last, only \$29 (reg. \$59.95) plus \$2.95 P&H. Send check to: **EVP, PO Box 2201, Northlake, IL 60164-0201** or call 1-800-754-5096 now!

DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), DSD, Datability, Dialog, other DEC compatibles, and Computer Output Microfilm (COM) units. Please call for a quote or fax us your equipment list. We buy, sell, and trade. **KEYWAYS, INC.**, 937-847-2300 OR fax 937-847-2350.

UTWE KNOWS what YOU want on the web! Pictures of the private parts collection of UTWE (yea, and cheap prices). See all those SCSI cases, the mainboards, the network cards, the disk drive controllers, video cards, network hubs, cables (you did realize I meant computer parts right?), keyboards, drives, sound cards, and some other new and used oddball stuff by stopping by www.utwe.com If you just want text deal sheets sent to you then E-Mail: deal sheets@utwe.com And of course, we still have a voice phone 626-930-1121 (10am-5pm PST) and fax 626-930-1123. E-Mail: sales@utwe.com

4 MB, 72 Pin SIMMs \$4 ea. Pikul & Associates, 314-937-0335.

MONITOR ADAPTERS. Convert OEM. (incl. PGA) 31.5KHz & above monitors with BNC connectors to PC use. Model VA10 VGA to RGB+ Sync \$45. Model VA11 VGA to R G/Sync B \$55. VA12 VGA to PGA (DB9) \$45. Pikul & Assoc., 101 Glenfield Dr., Festus, MO 63028. 314-937-0335.

EVERYTHING NEW w/warranty! P300MHz MMX \$195, 1.28 gigabyte HD \$65. 15"/17" SVGA monitors \$145/235. Pentium Class systems from \$350. Also multimedia kits, hard drives, scanners, printers, SCSI adapters \$25. Memory, cases, etc. Call for monthly specials. CCI 714-778-0450. E-Mail: cci@net999.com

P233 MHz Multimedia systems, fully loaded, liquidation price \$495. Laser printers \$175, color Inkjets \$95, Notebooks \$350, closeout prices on software. Call 714-778-0450.

CNC SYSTEMS! Write: motivity, Attn. Pam, PO Box 428, Rocklin, CA 95677. Call: 916-349-8757. Info/pictures at www.motivityusa.com A great place to buy CNC.

HARD DRIVE liquidation 1,280 megabytes \$65. 2,100 MEG \$85. Mouse \$1.95, SVGA monitors \$135, flatbed scanners \$75, 56K modems 45, 386SX40 \$25, 1.2/1.44 floppy \$20, Adaptec SCSI controllers \$45, memory 1.25/megabyte. 714-778-0450.

RAINBOW KITS

FAN CONTROLLER
Use this kit to control cooling fans, or any device that is temperature activated. Output is 100mA. For a 3 Amp application use the Relay kit RP-1 or the new Micro-controlled Relay PRC-1 kit. Temperature probe included. Operating voltage: 7.5 to 18V DC. Size: 1.5" x 1.2".
(Temperature Range 32°-200°F)
FC-1 KIT \$14.95

FLASHING SAFETY LIGHT
• Push ON / Push OFF switch.
• Flashes 3 weeks on 2 AAA batteries.
• Great for kids, bike riders and joggers.
• Keep in car for emergencies.
• Tough ABS case with belt clip.
• Size: 1 3/8" x 2 1/4" x 1 1/8"
BFL-3 BUILT \$6.95
2 for \$9.95

WIDE BAND PRE-AMP Uses PCB and surface mount technology for better performance. Use this for scanners, HTs, Frequency counters, Satellite Receivers. It amplifies low-level (weak) signals. If the signal is extremely low, two amplifiers can be used in a series.
• 1MHz to 2.5 GHz 2.8dB NF
• 1dB compression=0dBm
• Gain: 1MHz-20dB to 2.5GHz-6dB
• Power requirement: 12v @ 50mA
WBA-6 KIT \$19.95

KEY CHAIN LASER PEN
Comes with 4 extra heads
• Smiley face • I Love You • Hearts • Skull (all different) 2 1/2" Long. 4mm/650 nm
LP-4 BUILT \$12.95

TV NOTCH FILTERS FOR CHANNELS 2 thru 22 ONLY
Our TV filters eliminate unwanted TV channels or interference that alters both sound and video with a BEEP BEEP BEEP. Works on cable channels (2 thru 22) only.
NOTE: All TV Filter Kits are sold for educational purposes only. You must obtain permission from your local cable company before using these filters on your cable system.
DF-222 KIT \$14.95

FM STEREO TRANSMITTER Have your own FM radio station. Any stereo signal you plug into the FMST-100 transmitter kit will be transmitted to any FM radio tuneable from 76 to 108MHz FM. Plug in your CD player, tape deck and have a wireless link to any FM radio, within 200 ft. Listen to your CD while mowing the lawn. Transmit from your car to your camper, or through an auditorium. Transmit music on one channel sing on the other. Compatible with any audio system. Clarity is excellent, approx. 40dB stereo separation. Length of antenna determines distance of transmission. Comes complete with left & right input level control as well as a crystal for left & right stereo separation. ANTENNA NOT INCLUDED 9v Battery operation.
FMST-100 Cabinet SIZE: 1.5" x 1.6" KIT \$29.95
SIZE: 1.5" x 2.5" x 3" \$8.95

RAINBOW MINI-LIGHT Super Bright Flashlight
• LED's don't burn out!
• Battery lasts for years!
• If you have your keys, you'll have a flashlight.
• Replaceable battery!
• Better buy 2, your wife is going to take yours!
Lights up a complete bedroom at night
Red MLR \$9.95 each
Yellow MLY \$9.95 each
Blue MLB \$12.95 each
White MLW \$12.95 each
Infrared MLI \$12.95 each
Extra batteries \$2.95
SHOWN ACTUAL SIZE

LIE DETECTOR
This kit can be great fun at parties. When you lie, generally your hands will sweat and the more you sweat the louder the tone. This kit allows you to measure these changes, only a slight amount of change will cause the tone to increase in frequency. Power requirement 6 to 12V DC. SIZE: 8" x 1.2"
LD-1 KIT \$9.95

BUSY PHONE LIGHT
Add this little kit to any or all of your telephones. When one phone is used a red LED will light on the other extension. This lets everyone know when your computer modem is in use. Power requirement 9V DC. SIZE: 1.1" x .6"
TEL-LITE KIT \$9.95
This Manual contains schematics, parts lists & P.C. board layouts for many of the Rainbow Kits. Use your own parts to construct our kits.
KIT BOOK \$14.95

SUPER SNOOPER BIG EAR
Listen through walls, hear conversations across the room. Add a parabolic reflector and hear blocks away. The BIG EAR can be hidden about anywhere. Makes an ultra sensitive intercom. Can be used as a 1.5W AMP. We supply a mini-electret mike in the kit. Power requirement 6 to 12V DC. SIZE: 1.75" x 1"
AA-1 BUILT \$29.95 KIT \$10.95

STROBE LIGHT
Do you need an attention getter, warning light, or flashing light for model airplanes? Then this kit is for you. Use it as an emergency light for your auto, radio tower, even use it on your bicycle. Has a variable flash rate. Power requirement 6 or 12V DC. Size: 3.5" x 1.8"
ST-1 KIT \$11.95

AUDIO PREAMP
Boost your microphones output up to line level! Plug your mic into our AP-1 and drive your amp, to full capacity. Connect an AP-1 to a pair of amplified speakers, plug your mic in and you have an instant PA system. Requires 6 to 12V DC. Size: 1.75" x 1"
AP-1 KIT \$9.95

16 TONE DECODER
Sweet 16 tone decoder operates great over phone lines, radios or scanners.
• 16 TTL Level Outputs
• DTMF Decoder Decodes 16 different touch tones using the phone, radios, or scanners.
• One relay & driver circuit on board.
• 9v battery powered. Size: 2 3/4" x 2 1/8"
TT-16 KIT \$34.95

WIRELESS FM MICROPHONE
Small but mighty this little jewel will out perform most units many times its price. It really stomps out a signal. The WM-2 kit is a buffered wireless mike that operates from 80MHz to 120MHz FM, the frequency of any broadcast FM radio. Includes a mini-electret mike. 6 to 12V DC. SIZE: 1.25" x 1"
WM-2 KIT \$14.95

DC VOLTAGE MONITOR
If battery status is important, you need this kit. This kit uses 7 LEDs to monitor 12v DC in 1v, 1/2v, or 1/4v steps. Monitor 8v or 5v in 1/4v steps. Great for boats, motor homes, model planes or race car ni-cads. All parts and instructions are included. SIZE: 1.3" x 2.7". If you want to switch more power see our Triac (TP-1).
VM-1 KIT \$7.95
For 110 AC VM110 KIT \$10.95

WATER ALARM
Don't ever get stuck with a flooded basement or over fill your water bucket. When the liquid level reaches the sensor it automatically turns the pump on or off. The Water Alarm supplies you with 100 mA of output that activates a relay (that you supply). This relay can turn on a sump pump, or in applications where you are filling a area with liquid it turns off the pump. Sensor included. Size 1.4" x 2"
WA-2 KIT \$17.95

INDUCTANCE METER
This is the kit everyone has been asking for. Turn your digital volt ohm meter into an inductance meter. It will read inductors 3uH to 7MH. Power requirement 9v DC. SIZE: 1.75" x 2.5"
IA-1 KIT \$14.95
IA-1 CABINET \$8.95

DIGITAL THERMOMETER
The DT-3 kit will turn your digital volt ohm meter into an accurate digital thermometer with .1 degree resolution. Measure temperatures from -40° to 250F°. The remote sensor is .25" sq. and can be mounted many feet from the meter. Power requirement 9V DC. SIZE: 2" x 1.35"
DT-3 KIT \$8.95

CAPACITANCE METER
This kit will turn your digital volt meter into a capacitance meter. Turn that junk box of unmarked capacitors into a fortune of usable parts. Measure capacitors from <2.2pF to 2.2uF. Power requirement 9v DC. SIZE: 1.80" x 2"
CA-1 KIT \$12.95

VOICE ACTIVATED SWITCH
This VOX circuit can be used to operate a tape recorder, ham radio, CB radio, or turn on an alarm. The VOX-1 kit has 100mA of output that operates a relay, light, motor, ? What could you do with a sound activated switch? Power requirement 7.5 to 18V DC. SIZE: 1.5" x 1.3"
If you want to switch more power see our Triac (TP-1) or Relay (RP-1) Power kit.
VOX-1 KIT \$6.95

PHONE RECORDING SWITCH
This phone line powered switch is small enough to be installed anywhere. Every time the phone is picked up the recorder will record both sides of the conversation automatically. Use it in your office to record all phone calls so you don't lose important information. SIZE: 1" x .6"
If you want to switch more power see our Triac (TP-1) or Relay (RP-1) Power kit.
TEL-SW1 KIT \$12.95

WATER ALARM
Don't ever get stuck with a flooded basement or over fill your water bucket. When the liquid level reaches the sensor it automatically turns the pump on or off. The Water Alarm supplies you with 100 mA of output that activates a relay (that you supply). This relay can turn on a sump pump, or in applications where you are filling a area with liquid it turns off the pump. Sensor included. Size 1.4" x 2"
WA-2 KIT \$17.95

Electronic Rainbow Ind., Inc.
6227 Coffman Rd. Indianapolis, IN 46268
CALL 317-291-7262 FAX 317-291-7269
INTERNET: www.rainbowkits.com

SONY/AMIGA/MAC/IND. MULTISCANS
15" 0.26 DP 15.7-37KHz TTL/Analog,
sync on green, & 150 Blem 15" SVSA's
\$85. Expert Sony repair. Refurbished.
Pikul & Assoc., 101 Glenfield Dr., Festus,
MO 63028. 314-937-0335.

CD DUPLICATOR MediaFORM Genesis
2601. Duplicate or master up to 25 CDs
at a time. Accepts most CD formats.
\$4,200 or best offer. GearHead
Electronics, PO Box 413, Williamsville,
NY 14231-0413, 716-636-4370,
http://www2.pcom.net/gearhead

LOOKING FOR cheap clone PC parts
that actually work? Call UTWE for CD-
ROMs, hard drives, disk controllers,
video cards, mainboards CPUs, etc. For
example, NEW Clone-o-matic mainboard
with 4 PCI, 3 ISA, 256K cache, I/O built
on board with 200MHz AMD \$100, 2
meg PCI S3 video board \$20. 486 "all in
one" mainboard (video and IDE IO) \$35
ea. Remember, today we have, tomorrow
we don't! For all the latest deal sheets E-
Mail: dealsheets@utwe.com Call 626-
930-1121 (10am-5pm Pacific) or fax 626-
930-1123. E-Mail: sales@utwe.com

SVGA MONITOR, \$60; 486 computer
with SVGA monitor, \$125; 15" SVGA
monitor, \$100, HP plotter 7475, \$50; HP
plotter 7550A, \$75; Macintosh monitor,
\$50, Macintosh powerbook 140, 230,
\$150. Much more call 714-827-7345

COMPUTER SOFTWARE

FREE IBM DISK CATALOG of quality
Shareware and CD-ROMs. **MOM 'N'**
POP'S SOFTWARE <ASP>, PO Box
15003-N, Springhill, FL 34609-0111.
352-688-9108. momnpop@gate.net

**LINUX & FREEBSD & LINUX &
FREEBSD** Linux and FreeBSD distribu-
tions on CD-ROM for as low as \$1.99.
See our full range of Linux products and
books at **incredible prices**. Use our
secured shopping cart system at
www.cheapbytes.com Visa and
MasterCard gladly accepted. E-Mail:
sales@cheapbytes.com fax: 209-367-
8518. CheapBytes, PO Box 2714, Lodi,
CA 95241.

MOD CHIPS for Sony PlayStation. Now
your backups will work. Only \$9.95 ea. +
\$3 shipping. Call 1-888-467-6150, all
major credit cards accepted. Computers
& components at wholesale prices.
www.cconusa.com

MAKE \$\$\$ giving away our software!
Business kit \$10 (refundable). RASCOM,
860 E. Carson St. #118-89, Carson, CA
90745.

CAM & MOTION SW/HW: Z-trace, PCB
toolpath. Plotcam motion control, step
drivers. cmheater@juno.com MSG/FAX
407-452-7197, 407-459-2729.
www.megabits.net/ddt

LIQUIDATION WIN 95/98, Office97,
WindowsNT, 10 PACK CDs \$25, DOS
\$25, Lotus SmartSuite \$10, Wordperfect
Suite \$35. Antivirus \$5. Call 714-778-
0450.

**MICROSOFT OFFICE 97 PROFES-
SIONAL EDITION**, \$79. That's right,
\$79. Includes Word 97, Excel 97,
Access 97, PowerPoint 97, and
Outlook 97. Brand new, unopened,
and shrink-wrapped. Easy fulfillment.
No manuals. Visa/MC accepted. Call
Gulf Professional Services toll-free 1-
888-208-9797, or order online at
www.gulfpro.com E-Mail: sales@gulf
pro.com

COMPUTER EQUIPMENT WANTED

WANTED: FOR historical museum, pre-
1980 microcomputers, magazines, and
sales literature. Floyd, VA 24091-0341
(540-763-3311/540-382-2935).

HP CALCULATORS wanted: models 10,
70, calculator watch, others for private
collection. Cash paid. Bob Morrow, 765-
855-2348, rkmorrow@aol.com

WANTED: TERMINALS + PRINTERS:
DEC, Wyse, IBM, ADDS, Okidata, Data
South, Epson, C.I.T.O.H., etc. Call for quote
on any surplus computer equipment. Call
Jeremy, 603-673-8077.

DEC EQUIPMENT WANTED!!! We are
buying DEC systems, boards, terminals,
drives and peripherals. Also Scientific
Micro Systems (SMS), DSD, Datability,
Dilog, other DEC compatibles, and
Computer Output Microfilm (COM) units.
Please call for a quote or fax us your
equipment list. We buy, sell, and trade.
KEYWAYS, INC., 937-847-2300 OR fax
937-847-2350.

WANTED: IBM System 23 monitor
model #5324. Working or not, but com-
plete. Will pay shipping. Dick Lotz, 3282
Zoeller Rd., Alden, NY 14004.

TEST EQUIPMENT

SUCH A DEAL! Check out Metric's
"Current Specials" at **http://www.metric
sales.com** Great deals on top quality
reconditioned test equipment. Call 1-
800-432-3424 for a free catalog.

FEITEK PROVIDES repair, calibration
and traceable certifications of test equip-
ment. Free estimates. We buy, sell and
trade all makes of test equipment. Visa
and MasterCard accepted. Check out our
inventory and specials at **WWW.FEIT-
EK.COM** 2752 Walton Road, St. Louis,
MO 63114, 314-423-1770.

Tired of Expensive Inkjet Cartridges ?

Save 90% on Inkjet Inks !

Printer	# of Refills		Cost/Refill		Kit Price	
	Black	Color	Black	Color	Black	Color
HP 500 Series, 400, Officejet 300, 350, Fax	7	14	4.71	2.85	32.95	39.95
HP 600 Series, Officejet 500, 570, 600	7	14	4.71	3.21	32.95	44.95
HP 800 Series, 1000C, 1150C, Copier 120, 210	6	10	6.67	4.00	39.95	39.95
HP 720C, 722C, 890C, 1120C	6	10	6.67	4.50	39.95	44.95
Canon BJ-10, 200, 210, 240, 250 Apple SWriter 1200, 1500	14	20	2.15	2.00	29.95	39.95
Canon BJC-4000 Series, C2500, C3000, C3500, C5000	60	60	0.50	0.67	29.95	39.95
Apple StyleWriter 2400, 2500						
Canon BJC-600, 610, 620 Apple SWriter Pro	20	13	1.50	3.07	29.95	39.95
Epson Stylus Color, Color Pro, Pro XL	12	12	2.50	3.33	29.95	39.95
Epson Stylus Color II, IIs	15	15	2.00	2.66	29.95	39.95
Epson Stylus Color 500, 200	20	17	1.50	2.35	29.95	39.95
Epson Stylus Color 400, 600, 800, 850, Photo	20	17	1.50	2.65	29.95	44.95
Lexmark JP 1000, 1020, 1100, ExecJet II, IIC, Medley 4C	10	17	3.00	2.35	29.95	39.95
Lexmark JetPrinter 5700, 5000, 7000, 7200	10	17	4.00	2.35	39.95	39.95
Xerox Home Center 450C, XJ6C Inkjet	22	12	1.36	3.33	29.95	39.95

SAVE 30 - 50% on New Compatible Cartridges!

Printer	BLACK	COLOR
	CARTRIDGE	CARTRIDGE
Canon BJC-4000 Series, C2500, C3000, C3500, C5000	\$5.50	\$12.95
Apple StyleWriter 2400, 2500	\$5.50	\$12.95
Canon BJC-600, 610, 620 Apple StyleWriter Pro	\$4.95 (9cc)	\$4.95 @ (9cc)
Hi-Capacity Canon BJC-600, 610, 620	\$5.95 (15cc)	\$5.95 @ (12cc)
Canon BJC-70, BJC-80	\$9.95 (3-pak)	\$14.95 (3-pak)
Epson Stylus Color, Color Pro, Pro XL	\$12.00	\$19.00
Epson Stylus Color II, IIs	\$14.00	\$19.00
Epson Stylus Color 500, 200	\$14.00	\$19.00
Epson Stylus Color 400, 600, 800, 850, 1520, Photo	\$14.00	\$19.00

- **BULK Inks, Refill Accessories**
- **Glossy card stock & Coated Paper**
- **School & Government PO's Welcome**
- **2 - 3 Day Shipping**

Quality Inks for:
HP • Epson • Lexmark
Canon • Apple • DEC

Inkjet

Southwest



Call or see us online!

Monday - Friday

7:30 - 4:30 PST 10:30 - 7:30 EST

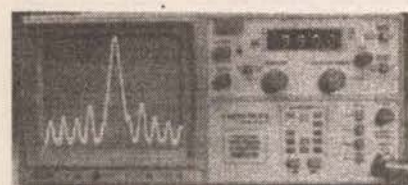
www.inkjetsw.com

(602) 668-7334 Fax

1-800-447-3469

(602) 668-0959

TEST EQUIPMENT: HP 3590A wave analyzer + 3593A sweeping local oscillator \$500, HP 3702B IF/BB receiver + 3705A diff phase detector \$500, HP 5327B timer counter DVM \$350, HP 6131C digital voltage source 100V .5 amp \$375, HP 3760A data generator \$275, HP 3490A multimeter \$400, Nicolet digital oscilloscope 20903C + 204A plug-in \$595, Philips PM664A 520MHz counter \$200, Marconi TF791D carrier deviation meter \$200, Marconi TF1066B FM signal generator \$250, Marconi TF2300 FM/AM modulation meter \$350, Fluke 633A frequency synthesizer \$325, Eldorado Electronics 796 time interval counter \$175, Berkeley 6401A programmable counter timer \$200, Federal Scientific UA500 ubiquitous spectrum analyzer \$400, Rotek 146A absolute AC voltage standard \$275, LCI pipe laser PL120 with remote \$1,850. **BURTON EQUIPMENT** 513-897-1596. Fax 513-897-3837.



ENGINEER TESTED: Spectrum analyzers, frequency counters, frequency standards, meters, scopes, generators, curve tracers, temperature, time, weight, light, sound, distance, etc., measurement instruments. **VISA, MASTERCARD, AMEX.** "Performance tested." NIST calibrated. Warranted. New & used. Gary N6ZD. [HTTP://TECH-SERVICES.COM](http://TECH-SERVICES.COM)

ENI MRI 2000 2KW linear pulse power amp 15-65MHz, unused, \$1,600; National Bureau of Standards, variable rejection filters for the following frequencies: 220-440KHz, 1.75-3.5MHz, 55-110KHz, 27.5-55KHz, 110-220KHz, 440-880KHz, \$200 ea.; GR 1606A, RF bridge, \$400; RF communications 805, RF amp 50KHz-80MHz, 47dB, 7W PO, \$450; Tektronix 2235 100MHz scope, \$600; HP 1727A, 275MHz storage scope, \$650; HP 1712A, 200MHz scope, \$500; Tek TM504, \$150; DM 501A, \$200; FG503 3MHz function gen., \$200; PS503A, \$150; HP 3406A, RF voltmeter, \$400; Boonton 42B, RF voltmeter, \$250; HP 3490A, 5.5 dig DVM, \$300. A-Comm Electronics 303-341-2283.

TERRIFIC VALUES: HP 54100D 1GHz digitizing oscilloscope \$3,100; Tek AM 503, A6302 current probe, amplifier \$825; HP 83522A .01 to 2.4GHz plug-in \$3,900; HP 83570A 18 to 26.5GHz plug-in \$4,900; HP 3488A mainframe \$650 (cards available); HP 8161A/020 100MHz dual channel pulse generator \$2,750; Stanford Research SR 510 lock-in amplifier \$975; HP 8410C, 8410B, 8410A network analyzer mainframes \$625, 450, 250; HP 8411A/018, 8411A harmonic frequency converters \$395, 295; HP 8743B/018, 8743A test sets \$575, 325. All in excellent condition with warranty. Pepper Systems (<http://home.earthlink.net/~peppersys>) 214-353-0257 (Fax 214-902-9511). E-Mail: peppersys@earthlink.net

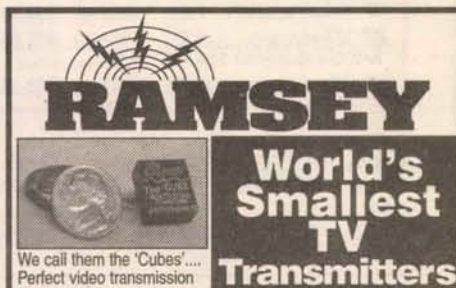
KENTRONIX TEST EQUIPMENT SPECIALS. Check our WEB site at <http://www.kentronix.com> for monthly specials. We are also looking to buy test equipment, coaxial and waveguide components, manuals, etc. Contact Brian at 732-681-3229 or FAX 732-681-3312. E-Mail: brian@kentronix.com

WANTED: RADIO service monitors, IFR, Motorola, HP, Marconi, also late model HP equipment. 716-763-9104 or Fax 716-763-0371. <http://www.amtronix.com>

TEST EQUIPMENT repair or overhaul Tektronix, HP, Wavetek, Boonton, etc. 20 years experience with former Slep Electronics Co., same excellent service same reasonable rates, satisfaction guaranteed. Brooks Electronics 828-349-3503. E-Mail: rwbrooks@dnnet.net

NEW HEWLETT-PACKARD 141T CRTs \$195 EACH. We have quantities available. These are double boxed, unopened with late 80's date code, guaranteed. Fits all Kentronix. 732-681-3229 or FAX 732-681-3312. Mailing: Kentronix, PO Box 2444, Farmingdale, NJ 07727 or E-Mail: brian@kentronix.com

EQUIPMENT MANUALS we have 1000's of service and operators manuals for all types of test and measurement equipment from 1950 to present. All test equipment manufacturers are represented. Call, write, or fax your want list. Please include mfg.'s manual P/N unit serial numbers if known. **Manuals Plus**, Box 549, TAD #601, Tooele, UT 84074. 435-882-7188, FAX 435-882-7195.

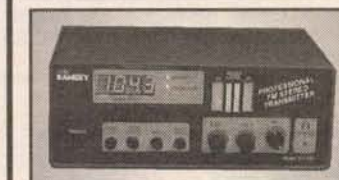


We call them the 'Cubes'... Perfect video transmission from a transmitter you can hide under a quarter and only as thick as a stack of four pennies—that's a nickel in the picture!

Transmits color or B&W with fantastic quality - almost like a direct wired connection to any TV tuned to cable channel 59. Crystal controlled for no frequency drift with performance that equals law enforcement models that cost hundreds more! Basic 20 mW model transmits up to 300' while the high power 100 mW unit goes up to 1 1/4 mile. Audio units include sound using a sensitive built-in mike that will hear a whisper 15 feet away! Units run on 9 volts and hook-up to most any CCD camera. Any of our cameras have been tested to mate perfectly with our Cubes and work great. Fully assembled - just hook-up power and you're on the air!

- C-2000, Basic Video Transmitter Cube.....\$89.95
- C-3000, Basic Video and Audio Transmitter Cube.....\$149.95
- C-2001, High Power Video Transmitter Cube.....\$179.95
- C-3001, High Power Video and Audio Transmitter Cube.....\$229.95

Super Pro FM Stereo Radio Transmitter



A truly professional frequency synthesized FM Stereo transmitter station in one easy to use, handsome cabinet. Most radio stations require a whole equipment rack to hold all the features we've packed into the FM-100. Set frequency easily with the Up/Down freq buttons and the big LED digital display. Plus there's input low pass filtering that gives great sound no matter what the source (no more squeals or swishing sounds from cheap CD player inputs!) Peak limiters for maximum 'punch' in your audio - without over modulation, LED bargraph meters for easy setting of audio levels and a built-in mixer with mike and line level inputs. Churches, drive-ins, schools and colleges find the FM-100 to be the answer to their transmitting needs, you will too. No one offers all these features at this price! Kit includes cabinet, whip antenna and 120 VAC supply. We also offer a high power export version of the FM-100 that's fully assembled with one watt of RF power, for miles of program coverage. The export version can only be shipped outside the USA, or within the US if accompanied by a signed statement that the unit will be exported.

- FM-100, Professional FM Stereo Transmitter Kit.....\$299.95
- FM-100WT, Fully Wired High Power FM Transmitter.....\$429.95

AM Band Radio Transmitter



Ramsey AM radio transmitters operate in the standard AM broadcast band and are easily set to any clear channel in your area. Our AM-25, 'pro' version, fully synthesized transmitter features easy frequency setting DIP switches for stable, no-drift frequency control, while being jumper settable for higher power output where regulations allow. The entry-level AM-1 uses a tunable transmit oscillator and runs the maximum 100 milliwatts of power. No FCC license is required, expected range is up to 1/4 mile depending upon antenna and conditions. Transmitters accept standard line-level inputs from tape decks, CD players or mike mixers, and run on 12 volts DC. The Pro AM-25 comes complete with AC power adapter, matching case set and bottom loaded wire antenna. Our entry-level AM-1 has an available matching case and knob set for a finished, professional look.

- AM-25, Professional AM Transmitter Kit.....\$129.95
- AM-1, Entry level AM Radio Transmitter Kit.....\$29.95
- CAM, Matching Case Set for AM-1.....\$14.95

AFFORDABLE HP power sensor repair! Most 8481As repaired for \$235 or less. We also handle 478As and many others. Call or fax for more information. Willamette RF, Inc., 541-754-7226, FAX 541-753-4629.

MICRODYNE 1100, 1200, 1400 series receivers all bands, FM and PM demods, SDU, IF filters. Aydin, Schlumberger, monitor systems bit syncs. 805-934-2058.

WANTED! ELECTRONIC test equipment. We pay top dollar for used scopes, generators, analyzers from HP, Tektronix, and others. Call Charles at Metric for immediate quotation. 1-800-432-3424 Fax: 510-264-0886.

CCD Video Cameras



If you're looking for a good quality CCD board camera, stop right here! Our cameras use top quality Japanese Class 'A' CCD arrays with over 440 line resolution, not the off-spec arrays that are found on many other cameras. You see, the Japanese suppliers grade the CCDs at manufacture and some manufacturers end up with the off-grade chips due to either cost constraints or lack of buying 'clout'. Also, a new strain of CMOS single chip cameras are entering the market, those units have about 1/2 the resolution and draw over twice the current that these cameras do - don't be fooled! Our cameras have nice clean fields and excellent light sensitivity, you'll really see the difference, and if you want to see in the dark, the black & white models are super IR (Infra-Red) sensitive. Our IR-1 Illuminator kit is invisible to the human eye, but lights the scene like a flashlight at night! Color camera has Auto White Balance, Auto Gain, Back Light Compensation and DSP! Available with Wide-angle (80°) or super slim Pin-hole style lens. They run on 9 VDC and produce standard 1 volt p-p video. Add one of our transmitter units for wireless transmission to any TV set, or add our IB-1 Interface board for audio sound pick-up and super easy direct wire hook-up connection to any Video monitor, VCR or TV with video/audio input jacks. Cameras fully assembled, including pre-wired connector.

- CCDWA-2, B&W CCD Camera, wide-angle lens.....\$99.95
- CCDPH-2, B&W CCD Camera, slim fit pin-hole len.....\$99.95
- CCDPH-2, Color CCD Camera, wide-angle lens.....\$149.95
- IR-1, IR Illuminator Kit for B&W cameras.....\$24.95
- IB-1, Interface Board Kit.....\$24.95

FM Stereo Radio Transmitters



Microprocessor controlled for easy frequency programming using DIP switches, no drift, your signal is rock solid all the time - just like the commercial stations. Audio quality is excellent, connect to the line output of any CD player, tape deck or mike mixer and you're on-the-air. Foreign buyers will appreciate the high power output capability of the FM-25; many Caribbean folks use a single FM-25 to cover the whole island! New, improved, clean and hum-free runs on either 12 VDC or 120 VAC. Kit comes complete with case set, whip antenna, 120 VAC power adapter - easy one evening assembly.

- FM-25, Synthesized FM Stereo Transmitter Kit.....\$129.95

A lower cost alternative to our high performance transmitters. Offers great value, tunable over the 88-108 MHz FM broadcast band, plenty of power and our manual goes into great detail outlining aspects of antennas, transmitting range and the FCC rules and regulations. Connects to any cassette deck, CD player or mixer and you're on-the-air, you'll be amazed at the exceptional audio quality! Runs on internal 9V battery or external power from 5 to 15 VDC. Add our matching case and whip antenna set for a nice finished look.

- FM-10A, Tunable FM Stereo Transmitter Kit.....\$34.95
- CFM, Matching Case and Antenna Set.....\$14.95
- AC12-5, 12 Volt DC Wall Plug Adapter.....\$9.95

RF Power Booster

Add some serious muscle to your signal, boost power up to 1 watt over a frequency range of 100 KHz to over 1000 MHz! Use as a lab amp for signal generators, plus many foreign users employ the LPA-1 to boost the power of their FM Stereo transmitters, providing radio service through an entire town. Runs on 12 VDC. For a neat, professionally finished look, add the optional matching case set.

- LPA-1, Power Booster Amplifier Kit.....\$39.95
- CLPA, Matching Case Set for LPA-1 Kit.....\$14.95
- LPA-1WT, Fully Wired LPA-1 with Case.....\$99.95

WANTED: WESTERN electric test equipment. Tube-type only please. Freq. measuring sets, oscillators, amplifiers, parts, tubes, etc. 1-800-251-5454.

BRUEL & KJAER BUY, SELL, BEST PRICES. EXCALIBUR ENGINEERING, 3198-C AIRPORT LOOP DRIVE, COSTA MESA, CA 92626. 714-540-0169, FAX 714-540-5417.

EQUIPMENT SALE: HP 8564, \$350; HP 95501A D/A power supply \$50; HP 1630G logic analyzer, with all pods \$450; 1630D, \$300; Anritsu 645A, both the sending & receiving unit for \$250; Leader LPS-151 DC tracking supply \$200. Psitech Plus 707-745-4804, SEE www.psitech-plus.com for more.

Treasure Finder Kit



Search for buried treasure at the beach, backyard or park. This professional quality kit can detect metal at a depth of up to 6 inches. Easy to use, just listen for the change in tone as you 'sweep' the unit across the surface - the larger the tone change - the larger the object.

Has built-in speaker or earphone connection, runs on standard 9 volt battery. Complete kit includes handsome case, rugged PVC handle assembly that 'breaks down' for easy transportation and shielded Faraday search coil. Easy one evening assembly. This nifty kit will literally pay for itself! That guy in the picture looks like he found something - what do you think it is - gold, silver, Rogaine, Viagra? You'll have fun with this kit.

- TF-1, Treasure Finder Kit.....\$39.95

Binocular Special

We came across these nice binoculars in an importers close-out deal. Not some cheap in-line lens jobs, these beauties have roof prisms, a super nice rubber armored housing over light weight aluminum. 10 x 25 power with fully coated optics. Includes lens cleaner cloth, neck lanyard and nice carry case. For extra demanding use in bright sun, choose the EX module with ruby coated Objective lens. First quality at a close-out price! We've seen the exact same units with the 'Bushnell' name on them being sold for \$30 more!



- BNO-1, Binoculars and case.....\$24.95
- BNO-1EX, Ruby Coated Lens Binoculars and case.....\$29.95

Speech Descrambler

Decode all that gibberish! This is the popular descrambler / scrambler that you've read about in all the Scanner and Electronic magazines. Speech inversion technology is used, which is compatible with most cordless phones and many police department systems.



hook it up to your scanner speaker terminals and you're in business. Easily configured for any use: mike, line level and speaker output/inputs are provided. Also communicate in total privacy over telephone or radio, full duplex operation - scramble and unscramble at the same time. Easy to build, all complex circuitry contained in new custom ASIC chip for clear, clean audio. Runs on 9 to 15VDC. Our matching case set adds a professional look to your kit.

- SS-70A, Speech Descrambler/Scrambler Kit.....\$39.95
- SSS, Custom Matching Case and Knob Set.....\$14.95
- SS-70AWT, Fully Wired SS-70A with Case.....\$79.95
- AC12-5, 12 Volt DC Wall Plug Adapter.....\$9.95

Call for our Free Catalog!

See our complete catalog and order on-line with our secure server at: www.ramseyelectronics.com

RAMSEY ELECTRONICS, INC.

793 Canning Parkway Victor, NY 14564

Order Toll-free: 800-446-2295

Sorry, no tech info, order status at this number

Technical Info, Order Status

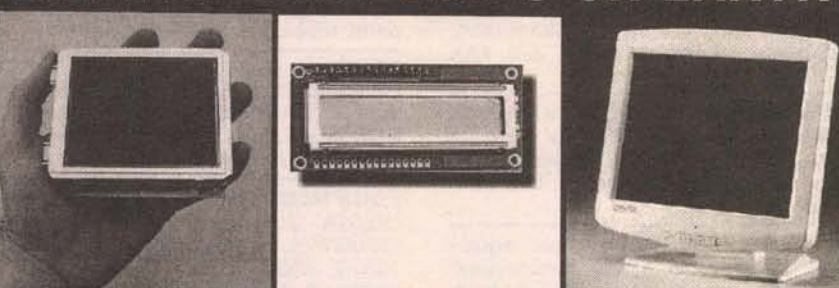
Call Factory direct: 716-924-4560

Fax: 716-924-4555



ORDERING INFO: Satisfaction Guaranteed. Examine for 10 days, if not pleased, return in original form for refund. Add \$6.95 for shipping, handling and insurance. Orders under \$20, add \$3.00. NY residents add 7% sales tax. Sorry, no CODs. Foreign orders, add 20% for surface mail or use credit card and specify shipping method.

LOWEST COST LCD'S ON EARTH



VIDEO LCD

4 Inch Video NTSC \$150
Sharp P/N 4LU4E
Composite NTSC & RGB Input
12:00 OR 6:00 Viewing Angle
Integrated Backlight & Inverter
Extended Temp: -10 to +60 C
Brightness: 260 nits
Power Consumption: 4.3 Watts
Contrast: 50 to 1

CHARACTER LCD

OPTREX DMF-5005SN-EW
240 x 64 Graphic EL Backlit STN \$30
OPTREX DMF-5005N
240 x 64 Graphic Reflective STN \$30
SANYO DM2023-7G1
2 x 20 Character Reflective STN \$8
SHARP LM20A21
2 x 20 Character Reflective STN \$8
VIKAY 2035TNLD NOTW-D
2 X 16 Character LED Backlit STN \$8

LCD MONITOR

10.4" DSTN or 12.1" TFT
Analog SVGA Input
Autosync
Auto Sizing
Automatic Expansion of VGA
images to SVGA (On 12.1")
Very Aggressive Pricing
Starting under \$500!



TOUCH MONITOR

EarthVue 10.4
10.4" VGA TFT
Analog VGA Input
105 Nit Brightness
RS-232 Touch Screen Option
Only 9.9"W x 7.7"H x 1.5"D
Ideal For Factory Automation
Fully Articulating Ball Mount
Only \$1095 With Touch



LCD DISPLAYS

6.3" Mono STN \$60
9.4" Mono Reflective \$60
8.4" TFT \$250
9.4" DSTN \$150
10.4" TFT \$350
10.4" DSTN \$240

NoteBook Screens
340 Models in Stock
Obsolete Screens Stocked
Hard To Find LCD? Call!



CONTROLLERS

ISA
PCI
PC/104
NTSC
Analog VGA
Complete LCD Kits with LCD,
Controller & Cable Starting
under \$200



EARTH

Computer Technologies

"The World Leader In LCD Recycling"

Ph: (949) 361-2333 Fax: (949) 361-2121

<http://www.flat-panel.com>

Write In 63 on Reader Service Card.

Mr. NiCd

DECEMBER SUPER SPECIALS!

THE BEST BATTERIES
IN AMERICA!

Packs & Charger for YAESU FT-50R / 40R / 10R:

FNB-40xh Sim-NMH 7.2v 650mAh \$41.95
FNB-47xh (NMH) 7.2v 1800mAh \$49.95
FNB-41xh (5w NMH) 9.6v 1000mAh \$49.95

For YAESU FT-51R / 41R / 11R:

FNB-38 pack (5W) 9.6v 700mAh \$39.95
For YAESU FT-530 / 416 / 816 / 76 / 26:

FNB-26 pack (NMH) 7.2v 1500mAh \$32.95
FNB-27s (5w NMH) 12.0v 1000mAh \$45.95

For YAESU FT-411 / 470 / 73 / 33 / 23:

FNB-11 pack (5w) 12.0v 600mAh \$24.95
FBA-10 6-Cell AA case \$14.95

Packs for ALINCO DJ-580 / 582 / 180 radios:

EBP-20ns pack 7.2v 1500mAh \$29.95
EBP-22nh pk. (5w) 12.0v 1000mAh \$36.95

EDH-11 6-Cell AA case \$14.95

For ICOM IC-21A / T22-42A / W31- 32A / T7A:

BP-180xh pk. (NMH) 7.2v 1000mAh \$39.95
BP-173 pack (5w) 9.6v 700mAh \$49.95

For ICOM IC-W21A / 2GXA / V21AT: (Black or Gray)

BP-132s (5w NMH) 12.0v 1500mAh \$49.95

For ICOM IC-2SAT / W2A / 3SAT / 4SAT etc:

BP-83 pack 7.2v 600mAh \$23.95

For ICOM 02AT etc & Radio Shack HTX-202 / 404:

BP-8h pack 8.4v 1400mAh \$32.95

BP-202s pack (HTX-202) 7.2v 1400mAh \$29.95

For KENWOOD TH-79A / 42A / 22A:

PB-32xh pack (NMH) 6.0v 1000mAh \$29.95

PB-34xh pack (5w NMH) 9.6v 1000mAh \$39.95

For KENWOOD TH-78 / 48 / 28 / 27:

PB-13 (original size) 7.2v 700mAh \$26.95

For KENWOOD TH-77, 75, 55, 46, 45, 26, 25:

PB-6x (NMH, w/whg plug) 7.2v 1200mAh \$34.95

Mail, phone, & Fax orders welcome! Pay with
Mastercard / VISA / DISCOVER / American Express

Call 608-831-3443 / Fax 608-831-1082

Mr. NiCd - E. H. Yost & Company

2211-D Parview Road, Middleton, WI 53562

CALL OR WRITE FOR OUR FREE CATALOG!

Cellular / Laptop / Videocam / Commercial & Aviation packs tool

E-mail: ehyost@midplains.net

CAPANALYZER 88 finds bad caps in-circuit with 100% accuracy. Checks both ESR and DCR, auto-discharge feature. Money back guarantee. www.eds-inc.com 561-487-6103.

LEAKSEEKER 82A tracks a shorted or leaky component to the EXACT location on the PCB. Range: zero to 150 ohms. Money back guarantee. www.eds-inc.com 561-487-6103.

WANTED: ELECTRONIC estates. Ham, broadcasting, military, test, public address, tubes, transformers, telex equipment. The bigger the pile, the more worthwhile. We fly anywhere. Sumner McDanel 1-800-251-5454.

BEST PRICES on guaranteed test equipment. Oscilloscopes, Tektronix 305, 454, 475, SC 504, 2225, 2246, & others. Huntron Tracker 2000, Fluke, HP and other fine used test equipment. Check us out at: www.lonemtn.com

SPECTRUM ANALYZER in a probe. \$249. View thru your inexpensive scope. WWW.spectrumprobe.com

LOWEST PRICES! Check out Metric's "Current Specials" at <http://www.metric-sales.com> Great deals on top quality refurbished test equipment. Call 1-800-432-3424 for a free catalog.

WANTED! ELECTRONIC test equipment. We pay top dollar for used scopes, generators, analyzers from HP, Tektronix, and others. Call Charles at Metric for immediate quotation. 1-800-432-3424 Fax: 510-264-0886.

WANTED! ELECTRONIC test equipment. We pay top dollar for used scopes, generators, analyzers from HP, Tektronix, and others. Call Charles at Metric for immediate quotation. 1-800-432-3424 Fax: 510-264-0886.

WE BUY electrical power systems test equipment. This includes the following manufacturers: Multi-Amp (now AVO Multi-Amp), Biddle or James G. Biddle (now AVO Biddle), Megger (now AVO Megger), Associated Research, AEMC, EIL, Programma or any other test equipment used for testing high voltage equipment and components. The test equipment that we are looking for is used for testing high voltage transformers, circuit breakers, cables, and protective relays. FAX 972-564-9139 or phone 1-800-261-9139 for quote. Phase-3 Power Test Equipment.

POOR MAN'S Spectrum Analyzer/Monitor Receiver Kit. 2 to 1,700 MHz. Basic kit only \$78. Now available with switched resolution filters, tracking generator and direct digital frequency readout. Works with ANY scope or IBM compatible computer. Send stamped envelope for details. Science Workshop, Box 310B, Bethpage, NY 11714. <http://www.science-workshop.com>

CUSHMAN CE3 \$175; Heathkit frequency counter SM2420 0-512MHz \$29; Tek 191 sig-gen \$100; Tek 465 & DM 40 \$125. Call for list. 909-873-1319.

DIGITAL, ANALOG, & RF test equipment. Closing R&D/manufacturing company. Must sell lots of equipment. Call 1-800-869-7827 or visit www.starcom.com for list.

SCOPE SALE: 475A DM44 \$500. 453 man, cover as new \$175, 465 \$175; 5223 as new \$200; Philips PM3217, \$200; Kikusui 50MHz 4 channel 5042, \$200; Tek 466, \$300; 7A13, \$100 LED; 7A18, \$45; 7A19, \$100; 7A26, \$60; 7B53A, \$60; 7B80/7B85, \$75 ea.; 7B92A, \$125; 7D15, \$175; DC504, \$100; FG-504, \$350; PG-508, \$350; S-2 sampling head \$150; SC-502 Scope \$200; SI-5010 as new \$200. CALL FOR OTHERS, all with 30 day warranty. Call Psitech Plus phone 707-745-4804. SEE www.psitech-plus.com for more.

FACTORY BOXED new 30 HSM 2GHz high-speed module \$450; Fluke 8921A True RMS voltmeter, \$300. Psitech Plus, 707-745-4804, fax 707-747-5277. SEE www.psitech-plus.com for more.

NEW: POCKET TESTBENCH, tiny, portable, RS-232 instrument. Scope, logic, spectrum, counter, generator modes. Oricom Technologies, 303-449-6428 (www.sni.net/~oricom).

ELECTRONIX EXPRESS

WELLER SOLDERING STATION - MODEL WLC 100
• Variable power control (5 to 40 watts)
• Replaceable heating element
• Quality light-weight pencil iron
\$36⁹⁵

DUAL-TRACE OSCILLOSCOPE
W/HIGH RESOLUTION, BLUE CRT
INCLUDES PROBES, POWER CORD
2 YEAR WARRANTY
Goldstar 5020
20MHZ **\$349⁰⁰**

SCOPE PROBE 60 MHZ
SWITCHABLE X1, X10 **\$12⁹⁵**

DIGITAL MULTIMETER
WITH CAP/FREQUENCY/
TRANSISTOR TESTER
Model DM645 **\$34⁹⁵**

PAD-234
DIGITAL/ANALOG TRAINER
Complete portable workstation.
Variable and fixed power supplies, function generator, digital I/O, rugged design, high impact case.
Assembled **\$150⁰⁰** Kit **\$110⁰⁰**

POWER SUPPLIES
0-30 VDC, 0-3 Amp. Built-in current limiting, overload protected, constant voltage and current operation.
01PSGP4303A Analog Display **\$165.00**
01PSGP4303D Digital Display **\$189.00**

SOLDERLESS BREADBOARD

830 tie points. MB102PLT model features 3 binding posts and aluminum backplate.
Part No. 1-9 10+
MB102 5.95 5.00
MB102PLT 8.95 8.00

HELPING HAND WITH MAGNIFIER #060836 **\$3⁵⁰**

MOTION DETECTOR
\$2 ea. - 10 For \$15

LM555 10 Min. 22¢ ea.
LM741 10 Min. 27¢ ea.
74LS00 10 Min. 18¢ ea.
7805 Regulator 10 Min. 30¢ ea.
2N3904 10 Min. 6¢ ea.
PN2222 10 Min. 6¢ ea.
Red LED T 1 1/4 10 Min. 6¢ ea.
Green LED T 1 1/4 10 Min. 7¢ ea.
Yellow LED T 1 1/4 10 Min. 8¢ ea.
Photo Cell 10 Min. 65¢ ea.
100K Pot., 1" Shaft PC ML 10 Min. 15¢ ea.

SOLDERING IRON 3-WIRE

HIGH PERFORMANCE **\$5²⁵**
#060501

SOLDERING IRON STAND
W/SPONGE **\$3⁵⁰**
#060842

1 LB. 60/40 Solder Roll .031" **\$5⁹⁵**

DESOLDER PUMP W/TIP **\$3⁵⁰**
#060820

15 TURN POT **69¢ ea.**

Bourns 3006P series. All standard values available.

7 SEG. DISPLAY **60¢ ea.**
MAN72 C.A Red 0.3"
MAN74 C.C Red 0.3"

FREE CATALOG

MORE Low-Priced Items In Our **FREE** 216-Page Catalog

TERMS: Min. \$20 + shipping. School Purchase Orders, VISA/ MC, Money Order, Prepaid. NO PERSONAL CHECKS, NO COD. NJ Residents: Add 6% Sales Tax.

In NJ: 732-381-8020
FAX: 732-381-1572

365 Blair Road • Avenel, NJ 07001-2293

800-972-2225

<http://www.elexp.com>
email: electron@elexp.com

DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), DSD, Datability, Dialog, other DEC compatibles, and Computer Output Microfilm (COM) units. Please call for a quote or fax us your equipment list. We buy, sell, and trade. **KEYWAYS, INC.**, 937-847-2300 OR fax 937-847-2350.

TEST EQUIPMENT for sale/wanted: RF, Microwave, video and fiber optic. Cable TV, Broadcast TV, satellite and related industries. Wavetek, Tektronix, Hewlett Packard and other manufacturers. Spectrum analyzers, signal level meters, sweep systems, TDRs, OTDRs, and much more. PTL Test Equipment, Inc. Phone 561-747-3647 FAX 561-575-4635.

FOR SALE: IFR 1200S Service Monitor with tracking generator (option 12). Excellent condition, **used in lab only** (\$10k) **\$8,500**. 410-381-7970. gor don@faders.com.

SOLDER EXTRACTORS: Pace MBT200 solder/desolder, \$350; Pace SX25 with rotary vein pump bases rebuilt, \$175; Weller DS100 mint, \$250; Weller DS1000 digital readout, \$350. Soldering stations: Weller EC2000 digital readout, \$100, WTCP with Weller Ungar pencil new, \$50. Ultrasonic cleaner, \$75, Mesei hot tweezers, \$50. 310-515-2058.

HP SPECTRUM analyzers: 8555A, 8558, 8559, others. Performance guaranteed. Metrowest Technologies PH 508-478-7613, FAX 508-634-3854. www.metrowesttech.com

POWER METERS, HP 432A, 8478A, \$450; Wavetek 1034A, 1MHz-20GHz, -50/+10 dBm, AC or bat operation, \$450; Boonton 42B, 10MHz-18GHz, \$350; Boonton 42BD, digital 200KHz-12.4GHz, \$450; Bird 43, \$150. A-Comm Electronics 303-341-2283.

TEST EQUIPMENT for sale: http://www.A-COMM.COM

TEK 464 100MHz storage portable, \$300; 454A 150MHz portable, \$200; Racal 9000 500MHz counter, \$95; 9913 200MHz counter, \$55; HP 141T 110MHz spectrum analyzer, \$700; 7015B plotter, \$50; 1900A pulse generator, \$75; 3403C RMS DVM, \$90; 3581C 50KHz selective voltmeter, \$125; 5257A transfer osc., \$100; 5328A 500MHz counter, \$125; 86250A 8-12.4 GHz plug-in, \$150; ESI 291 RLC bridge, \$95. 949-495-8649.

TEST EQUIPMENT for sale. Contact Ken for list. AFTC 248-666-4178, Fax 248-666-2669.

CUSHMAN SERVICE monitor CE5 with 301A-305B and manuals. Recent cal \$500. CE5 with 302-305 repairable with manuals \$200. Avionics set 307B-313 AM monitor \$150. 315-839-5883.

BOONTON 82AD with manual \$300. Wavetek Sam 1000 \$250. Fluke 8060A \$150. HP 8761A switch, new \$40. 315-839-5883.

DATA RECORDS. Teac XR-5000 14 channel SVHS format \$5,000. Sony PC-204 portable 4 channel DAT format \$900. John 973-591-0523.

HP 3465A, HP 3465B digital multimeter, \$100; HP 59306A relay actuator, \$75; HP 428B, \$50; GR 1311A, 1232A, 1142A, \$50; HP 7475 plotter HP-IB interface, \$200; HP 1744A oscilloscope, \$200; HP 432A, \$50; Tek 321 oscilloscope, \$100; HP2225A printer HP-IB interface, \$50; Tek TM506, \$60; JDR 2000 oscilloscope, \$150; Tek P6452, P6455 data acquisition, \$25; Simpson multimeter 461, \$40. Call 714-827-7345.

DECEMBER SALE! Austron 1200 quartz modules, four 5MHz outputs, <1x10-10/day, voltage control, vacuum bottle insulated, works with July QST GPS controller, \$200. Many other frequency standards. Varion ion pump, ionization and capacitance gauges with readout. Corby Dawson 805-736-0288.

DATA-I/O 2900 programming system including LCC/PLCC and SOIC kits, lightly used, very clean, \$2,500. Lorand Enterprises, LLC, 718-447-4747 or E-Mail: lorand@banet.net

TEK SCOPES: We have most 2200, 2400 series in stock. Competitive prices. Metrowest Technologies PH 508-478-7613, FAX 508-634-3854. www.metrowesttech.com

HP PLOTTERS, 7475A six pen HP-IB, \$250; 7470A, 2 pen HP-IB, \$200; 7475A, RS232, \$150; 7550A, \$400. A-COMM ELECTRONICS 303-341-2283.

SPECTRUM ANALYZERS: Tek 7L5, 7L13 plugins and 490 series in stock. Metrowest Technologies PH 508-478-7613, FAX 508-634-3854. www.metrowesttech.com

TEK PLUG-INS: We have many on the shelf. Metrowest Technologies PH 508-478-7613, FAX 508-634-385. www.metrowesttech.com

SHOPPING FOR equipment: Metrowest Technologies, Bostons Equipment Supersource. Call for a quote on your next purchase. Metrowest Technologies PH 508-478-7613, FAX 508-634-3854. www.metrowesttech.com

SECURITY

MILITARY COMPONENTS wanted. Capacitors, resistors, diodes, transistors, semiconductors, ICs. Electronic Material Industries, 818-769-1002, FAX: 818-769-1084.



COUNTER-SURVEILLANCE=\$250 HR! Electronic eavesdropping is unbelievably widespread! Are you sure you're safe? Learn how others (without prior experience) earn **\$250 HR** in the fascinating field of COUNTER-SURVEILLANCE! For FREE catalog call: **1-800-732-5000**.

WE BUY & SELL!

C and H

SALES COMPANY

2176 E. Colorado Blvd.
Pasadena, CA 91107

Take advantage of our special purchase on TEST EQUIPMENT

HIGH PRECISION DIGITAL MULTIMETER

FLUKE, Model 8810A. LED readout. 5-1/2 digit auto-ranging multimeter. Has ohms converter and true rms options. Accuracy AC volts 0.1% to 0.5%, AC rms 0.2% to 0.4%, DC volts 0.01%, ohms 0.02% to 0.2%. Max input voltage 1000 VDC or peak AC. Input impedance to 1 to 1000 meg ohms depending on range. Power input voltage 115 VAC 50/60 Hz. Has built-in carrying handle that can be used as a tilting base. Dimensions: 9-1/4" wide x 14-1/2" deep (including carrying handle) x 3-1/4" high.



Stock #TE9805

\$295.00

3-1/2 DIGIT DIGITAL MULTIMETER

FLUKE, Model 8000A. LED readout. Classic digital multimeter. Ideal companion to our Stock #TE9800 counter. Measures AC/DC volts/milliamperes plus ohms. Input range 0-200 mV to 1200 volts, 0-200 uA to 2000 mA. 0 to 2000 K ohms. Portable unit with carrying handle which also can be used as a tilt stand. Input impedance 10 meg ohms. Max. input voltage 1200 VDC or rms. Accuracy DC volts 0.1% of input +1 digit. AC volts 0.5% of input +2 digits 45 Hz to 10 KHz. Input power 115 VAC 50 to 400 Hz 5 watts. Dimen.: 8-1/2" wide x 12" deep (including carrying handle) x 2-1/2" high.



Stock #TE9801

\$75.00

MILLIOMETER

HEWLETT PACKARD, Model 4328A. Designed to measure very low resistances. Measurement range 1m ohm to 100 ohms. Resolution 20 u ohms. Analog meter readout. Ideal for measuring contact resistance of switches or relays. This unit is also useful for measuring the resistivity of semiconductor devices. (Requires special 4 terminal probes which are not supplied, but probably are available from Hewlett Packard.) Power input: 115-230 VAC 48-66 Hz, 5 VA max. Dimensions: 5-1/8" wide x 11-1/2" deep x 6-1/2" high.



Stock #TE9812

\$200.00

200,000 COUNT DIGITAL MULTIMETER, FLUKE,

Model 8800A. LED readout. 6-digit, auto-ranging multimeter. Basic accuracy $\pm 0.05\%$. 15 ranges DC volts: ± 200 mv to ± 1200 in 5 ranges accuracy $\pm 0.08\%$ or better. AC volts: 2 VAC to 1200 VAC in 4 ranges. Accuracy $\pm 1\%$ or better depending on frequency and range. Resistance 200 ohm to 20 meg ohms in 6 ranges. Accuracy $\pm 0.2\%$ or better. Input impedance: 1000 meg ohms or more on DC ranges, 2 meg ohms on AC ranges. Has complete overload protection and isolated inputs. Power input 110/230 VAC 50/60 Hz 8 watts. Built-in carrying handle that also acts as a tilt-up base. Dimensions: 3-1/2" high x 9" wide x 12-1/2" deep.



Stock #TE9815

\$100.00

3600 RPM DC MOTOR WITH OPTICAL ENCODER PACIFIC SCIENTIFIC, #4VM82-004-4. 30 volts nom. input voltage. Permanent magnet, reversible servo motor. Has Hewlett Packard optical encoder. Ball bearings. No load speed at 30 VDC input is 4600 rpm. No load current 0.75 amp at 60 oz-in load rpm is 3600, current is approx. 6.6 amps. Torque constant is 9.1 oz-in per amp. Rotor inertia 0.0007 oz-in-sec². Terminal resistance 0.89 ohm. Optical encoder is similar to "HEDS 6000" series. Encoder has 1024 counts per revolution, two channel quadrature output. Outputs are TTL compatible. Encoder requires 5 VDC input at less than 50 mA input current. Dual shafts: front shaft is 3/8" dia. x 3/4" long. This shaft is tapped on the end 8X32 tpi. Rear shaft is 1/4" dia. x 7/16" long. This shaft has dual flats that measure approx 3/16" across. Motor has four 8X32 tpi tapped mounting holes on front. A 3-3/16" dia. centering pilot is also provided on the front face. Dimensions: 4" dia. x 5-1/2" long (excluding shafts.)



Stock #DCME9850

\$79.50

Call us first if you have surplus inventories of electronic, optical, or mechanical items for disposal

☒ Master Charge ☒ Visa ☒ American Express ☒ Discover

TOLL FREE: 1-800-325-9465

Write in 66 on Reader Service Card.

AMAZING PRODUCTS!

BOX 716 AMHERST, N.H. 03031

INFORMATION VISIT OUR "ACTION" WEB SITE@
UNLIMITED DEPT NV 01198 http://www.amazing1.com

LASER WINDOW BOUNCE LISTENING SYSTEM

Remarkable concept allows user to hear sounds within a premise over a beam of laser light reflected from a window or similar surface. Experimental device provides hours of interesting and educational use. Utilizes a visible red laser that simplifies alignment and discourages illegal use. Usable range will vary-expect about 20 to 50 meters. Optional lens will increase range 200 to 400 meters! Further range requires expensive optics. Basic system setup requires patience in alignment and a sturdy video tripod (not incl.)



Uses Scattered and Direct Reflections

LWB5 Plans.....\$20.00 LWB5K Kit/Plans.....\$149.95
LWB50 Basic System Assembled and Tested.....\$199.95
LWB70 Higher Performance Version With High Coherence Laser Gun Sight, Extending Lens, Deluxe Headsets.....\$299.95

KINETIC ELECTRIC GUN

PIONEER A FUTURISTIC WEAPON!
500 Joules Energy Storage
Constant Current Charging
Triggered Spark Switch
Ballistic Velocities
Handheld Battery Operated
Labeled A Dangerous product

EGUN1 Plans with Parts List.....\$20.00
All Parts are Individually Available

3 MI FM BROADCAST TELEPHONE TRANSMITTER

Tunable On FM Broadcast. Excellent Telephone Project. Only Transmits When Phone is Used
VWPM7K Kit/Plans.....\$39.95
BEEP1K Beeper Alert Kit.....\$19.95

10-14" of Explosive Bolts of Lightning 250KV TESLA COIL

Transmit Wireless Energy
Strange and Bizarre
Pyrotechnical effects.
Ion Motors Anti-Gravity
Size 20" H x 8" Sq
Weight - 25 Pounds
115 Volts/2 Amps AC
Labeled "Use Caution"

BTC3 Plans.....\$15.00
BTC3K Kit/Plans.....\$399.95
BTC30 Ready to Use.....\$499.95
BTC4 Plans 24 to 30" Sprk.....\$20.00

HIGH POWER STUNGUNS

STUN100 100KV StunGun.....\$19.95
STUN200 200KV StunGun.....\$39.95
STUN300 300KV StunGun.....\$49.95

LASERS

SUPER BRIGHT VISIBLE RED POINTERS

*Signaling Beacon Visible Over 25 Miles!!
*Over 1/2 Mile Pointing Range
*Light Up a Low Level Cloud
*Great Fun At The Mo
*Drive The Cat Nuts!!
*6Hrs On AAA Batteries
*5 5/8X1/2" All Metal
LAPN65 15 mw equiv 2000ft.....\$24.95
LAPN65F Above Focusable.....\$29.95
LAPN63 30 mw equiv 4000ft.....\$49.95
LAPN63F Above Focusable.....\$54.95

PRICE SLASH! LASER "LIGHT SHOW" POINTERS

*Projects 7 Complex Light Designs
*Produce a Small Light Show
LAPN65PT 640nm 7 Patterns.....\$19.95!!



FM TRANSMITTER KITS

ALL PARTS TO BUILD 6 LONG RANGE WIRELESS DEVICES

- 1 Super Sensitive Ultra Clear 1Mile+ Voice Transmitter
- 2 1 Mile + Telephone Transmitter
- 3 Line Powered Telephone Transmitter Never Needs Batteries!!
- 4 Tracking/Homing Beacon "Beeping Transmitter"
- 5 Transmitter Rebroadcasts Video or Audio Outputs
- 6 Short Range TV/FM Disrupter NEAT FRANKLIN Discretion Advised

All 6 Above Kits Plus FREE Info Data Pack on "HELPFUL HINTS Building and Tuning" Wireless Devices

COMBOX Parts and Plans for above.....\$59.95

COMBOP Plans for all the above.....\$10.00

ION RAY GUN

PROJECTS ENERGY!

Star Wars Technology Demonstrates Weapons Potential! See Ions in Motion!
IOG79 Plans.....\$10.00
IOG7K Kit/Plans.....\$99.95
IOG70 Assembled and Tested.....\$149.95

HIGHER POWERED DEVICE

IOG9K Kit/Plans.....\$149.95
IOG90 Assembled and Tested.....\$199.95

ATTENTION! HIGH VOLTAGE EXPERIMENTS

Battery Powered Mini Sized Modules for research in: HOVERCRAFT, ION GUNS FORCE FIELDS, SHOCKERS
MINIMAX4 4KV@10ma.....\$19.95

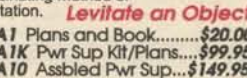
GRAVITY GENERATOR

Demonstrates a unique phenomena of electrical reactions that produce the effect of "anti-gravity". You build and levitate a small mock space ship from simple materials. Excellent scientific demonstration of a fascinating method of levitation. Levitate an Object!

GRA1 Plans and Book.....\$20.00
GRA1K Pwr Sup Kit/Plans.....\$99.95
GRA10 Assembled Pwr Sup.....\$149.95

SHOCK FORCE FIELD/VEHICLE OBJECT ELECTRIFIER

Hand Shock Balls, Wands, Electrify Objects. Great Payback for Those Wiseguy!
SHK1K Kit of Pwr Module.....\$19.95



1 800 221 1705 ORDERS ONLY! FAX 1 603 672 5406 INFO 9-5pm 1 603 673 4730 FREE CATALOG ON REQUEST
Pay by MC, VISA, Cash, Chk, MO, COD. Please Add \$5.00 S&H plus \$5.00 if COD. Overseas Please Contact for PROFORMA

Write in 66 on Reader Service Card.

Nuts & Volts Magazine/December 1998 51

FACTORY SALE! QVS 104: 4 BNC/RCA 12 pixels, 256 scale. 8.5" (W) x 2" (H) x 5.5" (L). \$169 @ 5 pcs., \$149 @ 10 pcs. Also available: 8-1 video auto-switcher, \$65 @ 5 pcs., \$58 @ 10 pcs. Distributors welcome. Matco, Inc., 1-800-440-0299 Fax: 630-350-9546. E-Mail: sales@matco.com

co.com Web site www.matco.com

SURVEILLANCE EQUIPMENT wanted. Audio, video, RF, telephonic, countersurveillance, communications, any other professional equipment. Fax 410-836-1190. E-Mail to Sales@swssec.com Voice 410-879-4035. www.swssec.com/used.html.

8 CAMERA DUO-QUAD DISPLAY BLOW-OUT. 8 camera B+W 2 page hires. real-time quad w/2 video outputs. Selectable display quad/sequencer or both. These units are brand new discontinued American Dynamics AD1475A.

Similar units in this magazine are twice the price. Not a China imitation. Industrial unit. Our reg. price \$350, **NOW \$175 EA.** While they last! Pro-Vid Sys. 781-933-0827. E-Mail: RicksVideo@MSN.COM

ALARM CATALOG of Ademco, Moose, Napco, CCTV, phones & more. 44 pages of equipment that only the professionals can buy. Send \$2 to HES Electronics, POB 183, Brick, NJ 08723. Mention this ad and get a \$10 off certificate! Visit www.heselectronics.com

AMATEUR SCIENTISTS: Surplus magnetic sensor board with Honeywell Micro SS94A1 Hall-Effect transducer (alone worth \$15) and other goodies. Output varies with magnetic field, two for \$10 postpaid. Check/MO to John Hill, 5734 Vickie Dr., Winston-Salem, NC 27106.



FACTORY SALE! CNL100, CNP101: 1/3" CCD, 430 line horiz., 12V/100mA, lens and pin hole types, lens 3.6mm/F2.0, 1.27" (W) x 1.27" (L) x 1" (H). \$43 @ 5 pcs., \$38 @ 10 pcs. Distributors welcome. Matco, Inc., 1-800-440-0299 Fax: 630-350-9546. E-Mail: sales@matco.com Web site www.matco.com



FACTORY SALE! IC 113: PIR motion detector w/ NO/NC alarm output. CCD camera with audio can be turned on by detector. 5-1/4" (L) x 2-3/4" (W) x 2" (D). \$89 @ 5 pcs., \$82 @ 10 pcs. Matco, Inc. 1-800-440-0299 Fax: 630-350-9546. E-Mail: sales@matco.com Web site www.matco.com



FACTORY SALE! AS 1000, 2.4GHz transmitter & receiver. Capable handling total of 4 wireless cameras, range: >300'. Built-in camera, 380 TV line. \$189 @ 5 pcs., \$179 @ 10 pcs. Additional camera \$99 @ 10 pcs. Matco, Inc. 1-800-440-0299 Fax: 630-350-9546. E-Mail: sales@matco.com Web site www.matco.com



FACTORY SALE! PS 102: Built-in pin hole CCD, lens size: 1.2mm. 5-1/2" (D) x 1.7" (H). \$69 @ 5 pcs., \$65 @ 10 pcs. Distributors welcome. Matco, Inc., 1-800-440-0299 Fax: 630-350-9546. E-Mail: sales@matco.com Web site www.matco.com



USED SATELLITE EQUIPMENT. You name it, we have it. LNAs, downconverters, drives, receivers. Working condition guaranteed. Call 765-385-2305.

FREE SATELLITE TV CATALOG. Tech books, installation videos, analysis software 1-800-843-2425 or www.baylin.com

SATELLITE EQUIPMENT available: Receivers \$25 and up; 20-25 LNB \$30; C-KU feed horns \$65. Call 757-599-4408.



FREE BIG dish catalog. Low prices! Systems, upgrades, parts, and "4DTV." Skyvision, 1010 Frontier Dr., Fergus Falls, MN 56537. www.skyvision.com Call 1-800-543-3025.

Unlock a World of Performance!



ACE COMPUTERS

Delivering Power and Performance for Less Since 1983

1425 East Algonquin Road
Arlington Heights, IL 60005
(847) 952-6900

(847) 952-6901 FAX

Call Toll-Free

1-877-ACE-COMP

www.acecomputers.com

"The Ace GamePro 2000 is a great gaming system with a price you'll like as much as the games you'll play!"
- Computer Buyer's Guide and Handbook, October, 1998

"A Power User's Delight!"
- Computer Buyer's Guide, Summer 1998

"Ace loads its system with enough high end components to turn a power user's head."
- Computer Shopper, August 1997

"Fast all around and affordable - an excellent value!"
- Computer Buyer's Guide and Handbook, July 1998

"Top 100 Direct Vendor!"
- PC Computing, February 1998

"BEST BUY - Ace has put together a system that's sure to please just about any consumer."
- Computer Buyer's Guide & Handbook, May 1998

"High quality components, Fast speed and Reasonable price - A real business workhorse!"
- PC Today, June 1998

"A fine system that would be valuable to any business - A great value!"
- PC Today, July 1998



"2 TIME BEST BUY - The right blend of nice touches - a computer worth seriously thinking about when it's time to buy."
- Computer Buyer's Guide and Handbook, August, September 1998

Pro Series Notebooks

TRACER/TRAVELER

- Intel Pentium® 233MHz/Pentium® II Processor
- 12.1" or 14.1" Active Matrix Screens
- 20X or 24X CD-ROMs and 1.44M FDD
- 64 Megs SDRAM
- 3 or 4 GB Hard Drive
- 56KB Fax/Modem
- 3D Sound with speakers
- Touchpad Mouse
- Full Travel Keyboard
- Carrying Case Included!
- Windows 98 Included!
- 1 Year Warranty

TRACER WITH PENTIUM® 233 w/MMX® (12.1", 3GB, 20X CD-ROM) - \$1499

TRAVELER WITH PENTIUM® II - 266 (14.1", 4GB, 24X CD-ROM) - \$2649

GamePro 2000

- Intel Pentium® II Processor w/512K Cache
- 64 Megs SDRAM/ 6.5GB Ultra DMA Drive
- Creative Labs DVD Drive Kit/1.44M Floppy
- US Robotics 56KB V.90 Fax/Modem
- Matrox G100 AGP with 8M SGRAM
- Diamond Monster II w/12M SGRAM
- 100 MB Zip Drive
- 20" (18.8" Viewable) SVGA Monitor
- Diamond Monster MX200® PCI Sound
- Pro SW-12 Subwoofer w/4 Satellite Speakers
- Microsoft Ergonomic Style Mouse/104 Kb
- Mini-Tower Case w/6 Bays
- Windows 98 Installed

PENTIUM® II 300 - \$2249
PENTIUM® II 333 - \$2279
PENTIUM® II 350 - \$2329
PENTIUM® II 400 - \$2479
PENTIUM® II 450 - \$2679

Intel FINANCIAL Leasing Available!
*Optional on-site warranties available on all systems!
*We accept all major credit cards. We accept Fortune 1000, Government, and Educational Institution Purchase Orders. We respond to invitations for governmental and educational open bids. Business leasing available to qualified applicants. Prices, appearance, and specifications subject to change without notice. 17" monitors are 15.9" VHS or better, 19" monitors are 18.0" VHS or better. Certain models may include upgraded components. All custom configurations are available. 15% restocking fee on returns of custom-built systems. 30 day return policy does not include shipping charges, incurred damages, or service charges. All returns must include original packaging, accessories, and documentation in as-new condition. Monitors may be manufactured by third parties. Viewable sizes of monitors vary. The Intel inside logo and Pentium are registered trademarks of Intel Corp.

Enhanced IDE & SCSI2 Hard Drives	Memory - SIMMs/DIMMs	Microprocessors	Motherboards for Pentium Processors
2.14 Gb Seagate/Western Digital, 10 ms access \$119	72 Pin SIMM Modules	Pentium® II-Xeon 450/400 w/512K/1279/1934	BCM 575 - Intel 430TX, P75-233PCI w/512K, DIMM, MMX \$88
2.55 Gb Seagate/Mediatech, 10 ms access \$125	4M NonParity/EDO/Parity \$10/10/15/19	Pentium® II-450/400/350 \$629/449/1299	Tyan Tomcat 4, Dual CPU, w/8 SIMMs, 512K \$159
3.2 Gb Seagate/Western Digital, 11 ms access \$135	8M NonParity/EDO/Parity \$18/18/25	Pentium® II-333/300/266 \$249/229/199	Tyan Turbo 2 AT/ATX, Intel 430TX w/8 SIMM/2 DIMM 512K \$89
4.3 Gb Seagate/Western Digital, 10 ms access \$145	16M NonParity/EDO/Parity \$35/35/49	Celeron® 333/300A/300/266MHz \$179/149/199/185	SuperMicro P55M598-Intel 430TX, 512K \$89
5.1 Gb Quantum Ultra DMA, 9 ms \$159	32M NonParity/EDO/Parity \$69/65/89	Pentium® Pro 200 Mhz 512K/256K \$449/429	Quicktek, P75-200 w/Adaptec 2940UW SCSI2, 512K Pipe \$159
6.4 Gb Seagate/Western Digital, 9 ms \$179	64M EDO/Parity \$109/129	Pentium® 233 MMX/200 MMX \$139/109	ASUS TX97ITX97E-AT-430TX P75-233PCI w/512K \$89
6.4 Gb Seagate/Mediatech, 10 ms \$179	168 Pin DIMM Modules	Pentium® 200 Mhz/166 MMX \$149/189	
8.4 Gb Quantum Fireball, Ultra DMA, 9 ms \$199	16M SDRAM 10 ns \$20	Pentium® 166 Mhz/133MMX \$85/79	
8.6 Gb Seagate/Mediatech, 9 ms \$199	32M SDRAM 10 ns/PC100 \$39/45	AMD K6-300/266/233 Mhz \$109/189/979	
9.1 Gb Seagate/Mediatech, 9 ms \$259	64M SDRAM 10 ns/PC100 \$85/89	Cyrix 266/233/200 \$89/79/69	
10.1GB Western Digital, 5400 RPM, Ultra DMA \$239	128M SDRAM 10 ns/PC100 \$175/185	Pentium® II/Pentium® Pro/Pentium® Tans \$129/124/8	
11.5GB Maxtor Diamondmax, 5400 RPM, Ultra DMA \$259			
13.6GB Maxtor Diamondmax, 5400 RPM, Ultra DMA \$319			
16.8GB IBM Deskstar, 5400 RPM, Ultra DMA \$439			
SCSI2 Drives	SVGA Monitors	CD-ROM/Modems/More	Motherboards for the Pentium® II Processor
2.1 GB Quantum Atlas Ultra Wide, 8 ms, 7200 RPM \$189	VISIONMASTER AWARD WINNING!	Acer 32X EIDE, 83 ms \$49	BCM 632 - Intel 440LX Chipset, PCI/ISA/AGP/AMI BIOS \$109
3.2 GB Quantum Fireball Ultra SCSI, 9 ms \$229	Iiyama Visionmaster 350-15" 0.28 Dot Pitch \$229	Goldstar 32X EIDE, 79 ms \$49	BCM OS440BX - Intel 440BX Chipset, 100 Mhz Bus, Audio \$139
4.5 GB Quantum Viking Ultra Wide SCSI2, 8 ms \$299	Iiyama Visionmaster 400-0.26 Dot Pitch \$17	Tohshiba EIDE 32X, 85 ms \$59	Intel AL440LX - Intel 440LX, PCI/ISA/AGP/DIMMs, Audio, ATX \$139
4.5 GB Seagate Barracuda Ultra/Ultra Wide, 7.9 ms \$449	Iiyama Visionmaster Pro 400, 0.25 AG-Editor's Choice \$489	Mitsumi EIDE 32X, 90 ms \$55	Intel SE440BX - Intel 440BX, 100 Mhz Bus, Audio \$169
8.7 GB Micropolis Tomahawk Ultra SCSI2, 8 ms \$399	Iiyama Visionmaster 450, 19" 0.28 AG-Editor's Choice \$629	Tohshiba SCSI2 32X, 85 ms \$99	Intel DK440LX/R440LX-Adaptec, LAN, Audio, 2 CPU \$449
9.1 GB Micropolis Tomahawk UW SCSI2 9 ms \$429	Iiyama Visionmaster 500, 21" Monitor, 1800 x 1440 \$999	Plexor Ultra SCSI2 32X, 75 ms \$169	Intel N440BX/7440BX - Adaptec, LAN, Dual/Sing \$579/6379
9.1GB Seagate Mediatech UW SCSI2 9 ms \$529	Iiyama Visionmaster Pro 500, 21" 1800 x 1440 Resolution \$1029	Mitsumi 2X/8X EIDE CDR Kit \$229	ASUS P2B - Intel 440BX, PCI/ISA/AGP, ATX \$149
9.1GB Quantum Viking UW SCSI2, 7.9 ms \$589	KDS VS-14" Non-Interlaced 0.28 Dot Pitch \$119	HP CD-Rewriter EIDE 4X/2X/24X \$499	ABIT LX-6 - Intel 440BX, PCI/ISA/AGP, ATX \$119
9.1 Gb Seagate Barracuda UZW 7.9 ms 1" High \$589	KDS VS-15" Non-Interlaced 0.28 Dot Pitch \$149	HP CD-Rewriter Parallel 4X/2X/24X \$499	ABIT BH-6 - Intel 440BX, PCI/ISA/AGP, ATX \$129
9.1 Gb Seagate Cheetha Ultra/Ultra Wide \$799	Sony Multiscan 155F Trinitron, Digital \$249	Teac 4X/12X SCSI CD-Writer \$399	Soltek SL61B - Intel 440LX, PCI/ISA/AGP/AT, SIMM/DIMM \$129
18.2 Gb Seagate Cuda/Cheetah Ultra Wide \$899/1399	KDS VS-7" 17" SVGA, 0.28 Dot Pitch \$289	Plexor Plexerwriter 4X/12X SCSI2 \$399	Soltek - Intel 440BX, 100 Mhz Bus, AGP/PCI w/with SCSI2 \$119/1229
SVGA Cards and Accelerators	Megapix 17" Non-Interlaced, 0.28 Dot Pitch \$329	Yamaha 4X/8X SCSI2 CD-RW \$429	Supermicro P60LE-440LX, Dual P2, PCI/AGP/DIMM \$229
Diamond Stealth 3D, 2M PCI/AGP \$39/149	Goldstar 78" Non-Interlaced 0.28 Dot Pitch \$299	Ricoh CDR-74 Media, 25 Pack \$40	Supermicro P60BI-440BX, Dual P2, PCI/AGP/DIMM/Dual SCSI \$219/2299
Diamond Speedstar AGP 8M \$69	KDS VS-9" 17" SVGA, 0.28 Dot Pitch \$329	Creative Labs DVD2 Kit (\$30 Rebate) \$199	Supermicro P65BI-440BX, Single P2, PCI/AGP/DIMM/Dual SCSI \$399
Diamond Monitor II 3D - 30FX VooDoo2 8M/12M \$179/1249	Panasonic S70, 0.27 Pitch, 3 Year/1 Year onsite \$399		Supermicro P65BA - 440BX/PCI/ISA/AGP/ATX, 100 Mhz \$149
Trident PCI 2M/AGP 4M \$29/49	NEC MultiSync XV17 - 0.25 Dot Pitch, ChromaClear \$499		Tyan T2000 - 440BX/PCI/ISA/AGP/ATX Form Factor \$159
Matrox Mystique 220 PCI w/4M RAM \$179	KDS V21 - 21" - 0.28 Dot Pitch, 1600 x 1280 \$749		Tyan Tiger II - 440LX, Dual Processor, ATX \$199
Matrox Productiva G100 w/8M AGP \$79	Viewsonic - Nokia - Hitachi - Mitsubishi - Others CALL		
Matrox Millennium II G200 AGP w/8M RAM \$129			
Matrox Millennium II 64M WRAM \$179			
ATI All in Wonder Pro PCI/AGP w/4M/8M SGRAM \$189/229			
ATI Xpert 8 Work/Expert 8 Play AGP 4M \$199			
Diamond Viper 550 Pro AGP/PCI w/16M RAM \$199			
Diamond FireGL 1000 w/8M SGRAM PCI/AGP \$179			
Matrox Rainbow Runner for Millennium II - \$169			
CAD ACCELERATOR CARDS - MANY IN STOCK PLEASE CALL!			

Don't See what you want listed? Just call us or see our Web site for a full catalog of fine quality products!

WWW.ACECOMPUTERS.COM

L BAND quadrifilar T/R antenna, 55 dB LNA, 20 watt HPA, works great for remote GPS. Info at afstar.com

MILITARY TRANSISTORS & DIODES & INTEGRATED CIRCUITS WANTED. ELECTRONIC MATERIAL INDUSTRIES 818-769-1002, FAX 818-769-1084.



BEST PRICING on 18" satellite TV systems for home and RV. DSS, DISH Network programming, multi-room viewing options, accessories. www.skyvision.com Call 1-800-543-3025.

KU UPLINK. 5.6 meter antenna, modulators, upconverters, TWT HPAs, exciter, test equipment, 26KVA generator. Closing company. Must sell lots of equipment. Call 1-800-869-7827 or visit www.starcom.com for list.

DSS TEST CARD information. Call toll free, 1-888-416-7296.

FREE SATELLITE TV INSTALLATION TOOLS AND EQUIPMENT CATALOGUE: for complete installation. Consumers, dealers, distributors and technicians welcome. 1-800-646-8665 or www.natropolis.com or fax 651-641-1898. Natropolis, Int'l, PO Box 14115, St. Paul, MN 55114.

1998 DSS SOFTWARE COOKBOOK 700+ CD-ROM COLLECTION CLONING REVERSE-ENGINEERING, PPV, ADULT, EMULATORS, DIAGRAMS, SCHEMATICS, PATCHES, PLANS, MUCH MORE. (SPECIAL: 1ST 500 ORDERS GET 500+ ADDITIONAL PROGRAMS!) WHOLESALE ONLY \$22 (BUY 2, GET 1 FREE!!!). DSS TEST-CARD INFO SOURCE MANUAL \$10. VISA/MC/AMEX/COD/CHECKS/MO. BRINKER ENGINEERING LABS, USA. CALL NOW 352-429-5496.

WHAT! YOU don't have TELECODE's NEW 1998 "HACKER CATALOG," yet! 125+ items. Call 520-726-2833. Surf online at <http://www.hackerscatalog.com>

MILITARY SURPLUS ELECTRONICS

MILLIONS \$\$\$ in "scrap gold" from old computers and electronics junk. Message: 603-645-4776 or www.tiac.net/users/quiksand/goldtek.htm

AUDIO — VIDEO — LASERS

8x8 PORT video/stereo audio switch. Electronic wideband patch panel eliminates complex wiring of your video and audio components. Easy signal routing via front panel controls using the MMCS-10. Call Communications Systems Labs at 1-800-529-9483 or check our web site at www.commsyslabs.com for this and more.



ANTIQUE VIDEO TRANSFER SERVICE: transfer of any 2" quadruplex video tapes. Quad TV spots, features, medical, corporate, military, government, and university tape libraries TRANSFERRED TO VHS. Affordable. Phone/fax 415-821-7500. If no answer call 415-821-3359 or pager 415-245-8700.

MOD CHIPS for Sony PlayStation. Now your backups will work. Only \$9.95 ea. + \$3 shipping. Call 1-888-467-6150, all major credit cards accepted. Computers & components at wholesale prices. www.cconusa.com

BROADCAST VIDEO equipment wanted: all types, new or old. Please call, Jon with info. 1-800-539-2859.

START YOUR OWN TECHNICAL VENTURE! Don Lancaster's newly updated **INCREDIBLE SECRET MONEY MACHINE II** tells how. We now have autographed copies of the Guru's underground classic for \$18.50. Synergetics Press, Box 809-K, Thatcher, AZ 85552. 520-428-4073. VISA/MC.

FREE LASER CATALOG. Helium-Neon, Argon, ruby, visible laser diode modules, lightshows, holography, laser pointers. Lowest prices. Midwest Laser Products, PO Box 262, Frankfort, IL 60423. 815-464-0085 www.midwest-laser.com

SYNC-A-LINK UNIVERSAL VIDEO SYNC GENERATOR restores all horizontal & vertical sync lines, DC level, compensates for inverted video, color phase, from standard or distorted analogue video-type formats. Comes complete with operations manual & 90-day warranty. \$160. 918-479-6451 or write to Sync-A-link Communications, PO Box 4, Locust Grove, OK 74352.

WANTED: PRO video equipment, VCRs, switchers, cameras, etc. Advanced Media 702-874-1911.

LASER POINTERS hottest novelty craze! Bullet style, metal cased, keychain pointers (not the cheap plastic styles). Highest quality, brightest laser for legal US use. Each packed in brilliant display case with batteries. All factory new and sealed with full one year warranty. We wholesale with the lowest prices on any quantity. Gentry Communications 507-332-2788.

SONY PLAYSTATION MODCHIPS. Allow you to play CDR backups & imports. \$10 ea. + \$3 shipping. Quantity discounts. 619-590-9320.

GATEWAY'S TOP 20

HERE ARE 20 OR SO OF OUR MOST POPULAR ITEMS...
check us out on the internet WWW.GATEWAYELEX.COM for more details on these items as well many other marvels of electronic gadgetry!

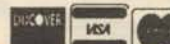
- photon microlight** - super bright led flashlight - available in red (\$13.50), yellow (\$13.50), blue (\$17.50), green (\$17.50), or white (\$17.50)
- amazing mini micro FM radio** - This tiny radio (1.5"x1.06"x0.38") has a seek button, reset control, nugget style earphones, and an on/off switch. (\$7.50)
- controlling the world with your PC book** - Here's a useful book that tells you how to connect your personal computer to the real world and make it do useful work like controlling stepping motors, monitoring fluid levels, or switching appliances on and off. No PC modification necessary for these projects either -- every circuit in this book connects directly to the parallel printer port of your PCI (\$35.00)
- Full Spectrum White LED** - Very bright 5mm (T1-3/4) white LED. Water clear lens. Operates on 3.6v. (\$4.95)
- virtual reality color video headset with audio and motion sensor** - great for video games and can also be connected to your vcr. (\$65.00)
- animal sounds piano kit** - build a piano that barks, oinks, and quacks! 8 switches serve as keys to play your tunes with traditional tones or 7 different animal sounds. (\$29.95)
- be a fly on the wall mini wireless fm transmitter kit** - With the entire FM broadcast band (from 88 - 108 MHz) for your receiver, and a transmit range of 300 feet, even James Bond would like this kit! Powered by a 1.5 volt watch battery (included) and features an electret type high gain microphone A lot of fun in less than a square inch!!! (\$19.95)
- geophone vibration sensor unit** - Detect a fly stomping across the desk! Well maybe not that sensitive, but almost. These vibration sensors made by Geosource® were used in oil exploration to determine geological statistics. They are made with a magnet suspended in a coil and are very sensitive to vibration. Compact size, the unit measures approx. 1.6" high and 1.2" dia. (\$7.95)
- geophone vibration sensing kit** - The kit includes a geophone vibration sensor along with parts to build a basic detector that will light an LED. In addition we include a schematic that will show you how to operate a relay. The sensitivity is adjustable, so you can set it to detect elephants and other small creatures. (\$9.95)
- passive infrared talking motion detector** - You speak into it to record your message (upto 12 seconds long), turn the unit on, and instantly your recorded voice responds to movement. Message can be changed with the flip of a switch. Uses 4 AA batteries (not included), or an external power source (built-in jack). May be used independently (80 db output) or with an amplified speaker to blast your message throughout the house. Approx 4"x3-1/2"x1-1/2". (\$27.50)
- computer service technician book** - The definitive guide to software and hardware troubleshooting, the CST covers processors, motherboards, CD-ROM, disk drives, tape drives, printers, memory chips, diagnostic programs, BIOS, chipsets, video, I/O ports and much more. Includes hundreds of illustrations, diagrams, and charts. Updated, 1998. (\$59.95)
- sugar cube camera** - A tiny enclosed (approx. 0.6"x0.6"x0.6") black & white camera with a pinhole lens. Operates on 9-12 VDC (works great on a 9V battery!) (\$165.00)
- brilliant 450nm blue LED** - 5mm (T1-3/4) blue LED -- the brightest we've seen. Operates on 3.6v. (\$4.95)
- Dr. Nicad, The nicad battery conditioner kit** - With this kit, you can build a rapid charger that eliminates memory effect and brings many batteries to full charge in less than an hour! Charge NiCad or NiMH packs from 2 to 10 cells (easily expanded) and current capacities up to 10 AH. Runs on 12-15 VDC. (\$49.95) Optional Matching Case (\$14.95)
- CD Stone CD-ROM/CD AUDIO multiple use benchmark, test and utilities CD Disc** - CD-Stone measures throughput and access time in a highly reliable and consistent manner, producing a meaningful benchmark for CD-ROM drives. This CD disc will help you obtain maximum performance from both stereo audio systems and your computer's CD-ROM drive. Includes tests for MPC levels 1 and 2 plus full audio reference playback facilities for the true audiophile with many options including Dolby Surround Sound tests, phase and frequency response tests in 2 formats, Windows (.WAV) format and in Real Audio Format for use in both home and mobile stereo audio systems. Additional utilities include extended drive and media information viewers with support for data capture. (\$7.95)
- VX1-R case** - specifically for the popular little Yaesu HT. A fully adjustable case made of a durable polypro web material, it features an elastic side slot to store your spare battery or drycell case (some aftermarket antennas fit well here too!), a heavy-duty velcro closure to keep your radio secure yet accessible, and a super strong velcro belt loop to attach conveniently to your belt. (\$12.50)
- lighted screwdriver supertool** - lighted at the top of the handle, with seven interchangeable bits stored at the base of the screwdriver (6 storage slots) for easy access. No handles to unscrew or tool boxes to dig through. Hey, you ain't seen nothin' yet...remove the bit and the magnetic retrieval tool telescopes from the screwdriver shaft! Incredible!!! Of course, the comfort grip handle and rugged construction are icing on the cake! Definitely a "gotta have it" tool! (\$9.95)

www.gatewayelex.com



8123 PAGE BLVD * ST. LOUIS, MO 63130 * (314)427-6116
9222 CHESAPEAKE DR. * SAN DIEGO, CA 92123 * (619)279-6802
2525 FEDERAL BLVD. * DENVER, CO 80211 * (303)458-5444
MAIL ORDERS CALL TOLL-FREE 1-800-669-5810
FAX ORDERS (314)427-3147

THE FINE PRINT: PRICES SUBJECT TO CHANGE WITHOUT NOTICE * GATEWAY IS NOT RESPONSIBLE FOR PRINTING ERRORS * MASTERCARD, VISA AND DISCOVER ACCEPTED * YES, WE'LL TAKE YOUR CHECK -- SORRY, NO C.O.D.'s * \$10 MERCHANDISE MINIMUM ON MAIL ORDERS * SUPPLY OF SOME ITEMS IS LIMITED * PRICES DO NOT INCLUDE SHIPPING * UPS GROUND SHIPPING/HANDLING WITHIN THE CONTINENTAL U.S. (ITEMS REQUIRING ADDITIONAL AMOUNTS ARE NOTED)...\$4.25 FOR THE FIRST ITEM, \$0.50 FOR EACH ADDITIONAL ITEM. RESTOCKING CHARGE MAY BE ASSESSED ON RETURNED ITEMS. WHY IS IT CALLED TOURIST SEASON IF WE CAN'T SHOOT AT THEM?



You Win with Nuts & Volts

Subscribe today and be
automatically entered in our **new**
MONTHLY PRIZE DRAWING!!!

OCTOBER PRIZE

BASIC Stamp II Professional Package

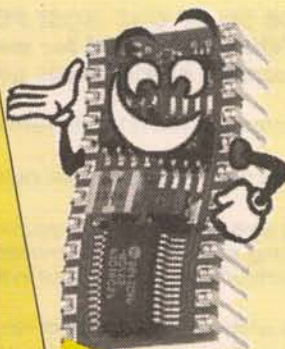
A custom-built package consisting
of the following parts:

JOHN DOGGETT

from Rovedale, AL IS OUR
**LUCKY WINNER OF THE
OCTOBER PRIZE!!
CONGRATULATIONS, JOHN!**

- (1) DCC1250
- (1) Standard Servo

Provided compliments of
PARALLAX, Inc.



A
\$350 Value

NOVEMBER PRIZE

HARD DRIVE DUPE-IT! PRO

from
**CORPORATE SYSTEMS
CENTER**

Pro model loaded with IDE
interfaces, tape drives,
and drive c...

**THE WINNER OF THE NOVEMBER
DRAWING WILL BE ANNOUNCED
IN THE JANUARY 1999 ISSUE!**

A
\$995 Value

To Subscribe –
Just fill in and mail the
enclosed subscription card or
call our toll free orderline at
(800) 783-4624 with a
Visa or MasterCard.

ATTENTION CURRENT NUTS & VOLTS SUBSCRIBERS:

If you have a current, paid subscription to Nuts & Volts, you
are automatically entered each month in our drawing!!

We now offer
a three-year
subscription
for only \$51.00!!
(USA delivery only)

If you do not wish to order a subscription,
but would like to be entered in our drawing,
simply **send or E-Mail** your name, address,
and telephone number, to NUTS & VOLTS,
430 Princland Court, Corona, CA 91719,
drawing@nutsvolts.com. No phone entries
accepted. All orders/entries must be
received by October 31st to be included in
the October drawing. November entries
must be received by November 30th.

Check us out on the web!
<http://www.nutsvolts.com>

ViewStar

Converter

Sale !!

**Best Quality,
Reliability &
Performance
DOC, FCC, UL,
Approved with
1 Yr. Warranty**



NEW !

Including Such Features And More:

- ◆ Double PLL Synthesized 550 Mhz Tuner ◆ On Screen Display
- ◆ Closed Caption Decoder ◆ Unlimited favorite Channel Recalls
- ◆ Full Text Fields ◆ Rapid Channel Scanning ◆ Parental Control
- ◆ Remote Control Included

	1-9	10-49	50+
85 Channel Converter	56	53	51
W/ Volume Control	69	66	63
W/ Closed Caption Decoder	98	90	85

(With Text & On Screen Display) (Freight included)

TECH-PLUS INDUSTRIES

Call 1-888-603-4439

Write in 68 on Reader Service Card.

**CREATE 3-D video images with the
Visual Eyes Video system.** Phone or
fax 918-479-6451 or write to Sync-A-
Link, PO Box 4, Locust Grove, OK
74352.

PICS, GALS READ if you've lost your
masters. Programming service available.
Call for info. Network Sales, 616-683-
0500.

CABLE TV

DEALERS: NEW VM8000 cable con-
verter. Sharp tuner, 800MHz. 125 chan-
nels. Call for lot pricing. NTS 1-888-355-
6687.

TOCOM UNMOD. 5503 cable converters
\$6 each. Call 706-398-2100. 10 lot min.

UNMODIFIED JERROLD 212 converter
\$50. 97.5, 106.5, 108.5, AB filters \$12
ea. DIGITAL 125ch PRO converter \$150
ea. 10 lot. The best converters you can
buy! Please call 1-888-561-4796.
<http://members.aol.com/Metro32168/index.html>



NOTCH FILTERS 110, 108.5, 106.5,
97.5 75dB deep notch. \$19.95 ea., 1-5
qty. \$15.95 ea., 6-10 qty. \$11.95 ea., 11-
20 qty. \$9.95 ea., 21 or more qty. Call 24
hr. order and information hot line 516-
389-3536.

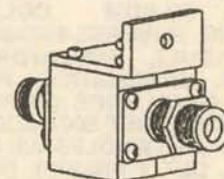
PANASONIC CATV converter, unmodi-
fied (Plain Jane) model TZ-PC 1203N,
TZ-PC 1103N and others **priced very
low. 407-676-2530.**

NEW! CABLE converter electronic ser-
vice equipment and supplies for most
cable converter boxes. Highest service,
lowest prices. Call Ken Erny Electronics.
24 hr. order and information hot line 516-
389-3536.

ADEAL4U WHOLESALERS BIG SAV-
INGS \$\$\$ **BEST QUALITY - NO CHEAP
CLONES** 888-387-1248 www.adeal4u.com

JERROLD UNMODIFIED CONVERT-
ERS FOR SALE. CALL FOR BEST
PRICES. NO DESCRAMBLER SALES.
CALL BRLD ELECTRONICS 1-800-322-
6316.

**PIONEER 6110, 6310s, READY TO GO,
SATISFACTION GUARANTEED,
SORRY NO NEVADA SALES, LESS
BUSTERS ELECTRONICS, 702-642-
0325, WEB: WWW.lessbuster.com**



EXPLOSIVE CABLE TV GRAB!
BRINKER ZAPPER/SNOOPER STOP-
PER combo module all in one! Buy
wholesale factory-direct, no middle-
man. Let others get fined + zapped
instead. 100% COMPATIBLE. Your
order shipped **NATIONWIDE** immedi-
ately! **LIFETIME GUARANTEE!**
VISA/MC/AMEX/COD/MO/
CHECKS. ONLY \$10 (SPECIAL: 3/\$20
plus FREE DESCRAMBLER PLANS!).
SUPER ZAPPER MODULES ONLY
\$16! (3/\$33)! Use SUPER ZAPPERS if
you have COX, TCI, WARNER in: CA,
TX, FL, NY, PA, MI. DESCRAMBLER
PLANS (4=\$5, 20=\$15) 130+
DESCRAMBLER SOURCES (\$5).
FREE SHIPPING. OPEN 24 HOURS!
352-429-5496. BRINKER ENGINEER-
ING LABS, USA.

125 CHANNEL Digital Pro converter
with audio & video \$82 each. Panasonic
TZ-PC175DG2-7 converter with volume
control \$135 each. The best converters
you can buy! Please call 1-888-561-
4796.

UNMODIFIED CABLE CONVERTERS.
Zenith ST1600, ST1086, ST300,
Panasonic 175, 145 vol. & non-vol. Regal
RR-92 & RC 83, DP5, DP7, DRZ, 5503
VIP, SA 8580. Guaranteed low prices.
Please call for more converters 405-631-
1856.

WANTED PIONEER 6110, 6310 CON-
VERTERS, RAW, TOP CASH, LOTS 5
OR MORE. 702-6452-0325.

PLANS: DESCRAMBLE CABLE FOR
UNDER \$12. PLUS TWO FREE
BONUSES. TOLL FREE 1-888-588-
3715.

FREE CABLE DESCRAMBLER
PLANS! For details write: Sierra
Publishing, 909 E. Yorba Linda Blvd.,
Suite H-181, Dept. NVJ, Placentia, CA
92870.

PANASONIC CATV converter, unmodi-
fied (Plain Jane) model TZ-PC 1203N,
TZ-PC 1103N and others **priced very
low. 407-676-2530.**

UNMODIFIED ST 1000 and ST 4000, \$20 ea. Bill 419-385-3100.

AS-IS converters Oak Sigma, \$20; Zenith, \$7; genuine unmodified DPV5, \$10. Call John 419-243-7856.

CABLE CONVERTERS, remotes, etc., free flyer. Jake 1-800-879-9657.

CABLE PARTS! Computer parts. Call for great prices or visit us on the Web: [HTTP://WWW.CB-Electronics.com](http://WWW.CB-Electronics.com) or call 1-800-436-8630.

SA UNMODIFIED all makes and models. Call for best prices 706-398-2100.

TOCOM UNMOD. 5503 cable converters \$6 each. Call 706-398-2100. 10 lot min.

CBTV REPAIR. We specialize in all converters, including Zenith. Give us a call: 405-634-1535.

ONE STOP shop. We carry a full line of CBTV equipment for all your cable needs. Also a wide variety of converter parts and accessories. Call for free catalog: 405-631-5153, FAX: 405-631-4788.

CABLE CONVERTER repair and upgrades most models, warranty. Call 972-304-5874.

ATTENTION: YOU'VE tried the rest, now go with the best. **UNICORN ELECTRONICS** where our valued customers **ALWAYS** come first. **CABLE CONVERTERS AND ACCESSORIES.** We will beat all competitors prices **GUARANTEED.** All **UNITS IN STOCK FOR IMMEDIATE SHIPMENT.** **FREE** batteries and coax cable. **FREE** bullet protection with every unit purchased. **FREE** shipping with a \$500 purchase or more. **NO** COD charges. **ALL** products come with a 1 year warranty and a 30 day money back guarantee. Please give us a call **TOLL FREE 1-888-738-8181** 9am to 6:30pm EST. **VISA, M/CARD, DISCOVER, COD.** **UNICORN** Electronics does not advocate unauthorized use or theft of cable services.

MOD CHIPS for Sony PlayStation. Now your backups will work. Only \$9.95 ea. + \$3 shipping. Call 1-888-467-6150, all major credit cards accepted. Computers & components at wholesale prices. www.cconusa.com

WANTED: TEKNIKA 6510 cable converter boxes/parts. 415-221-5940.

UNMODIFIED, POWER-UP, Pioneer BA: 6110, \$75; 5135 \$45; 5125 \$25; Jerrold DP5, channel 2: \$19, DPBB 7312, \$95; S/A 8590-7S7 (11 button) \$95. Minimum 10-lot. 405-631-5153.

LOW COST plain converters: Pioneer BC 4135, Hamlin CR-6000, DRZ-3, they're all 450MHz, 70 channel comes with new remote, 1 year warranty for only \$15 each. Panasonic: TZPC-170, 450MHz with volume, \$25 each; TV-86, \$25. Minimum 10-lot. Call 405-634-1535.

GENUINE UNMODIFIED JERROLD DPBB 7312. 1-800-804-8655. E-MAIL: CLEWIS7298@AOL.COM

CABLE PARTS & EVERYTHING. Parts & accessories. Best prices & quantity discount. **WE DON'T SELL BOXES.** 1-800-MODULE-0.

SONY PLAYSTATION MODCHIPS. Allow you to play CDR backups & imports. \$10 ea. + \$3 shipping. Quantity discounts. 619-590-9320.

TOCOM UNMOD. 5503 cable converters \$6 each. Call 706-398-2100. 10 lot min.

CONVERTERS WHOLESALE Regal CR83 \$35 each/10 lot. Panasonic 145-3 \$45 each/10 lot. Panasonic 175-3 \$50 each/10 lot. We also stock TV86, Timeless, RA550E, and Trivisions. Large selection of replacement remotes and batteries. Lowest prices on any quantity. Wholesale/distributors welcome. Gentry Communications. 507-332-27

PANASONIC TZPC175-3DG2: the original 175 with volume, parental control, and channel 3 output. Ideal for all your projects. \$50 each/10 lot. With remote! All units fully guaranteed, RAN, and repacked. We are the lowest priced wholesaler of Panasonic equipment. Gentry Communications. 507-332-2788.

ZENITH ST1000 unmodified \$16 each. Call 706-398-2100. 10 lot min.

ZENITH ST1600 unmodified \$60 each. Call 706-657-4445. 10 lot min.

JERROLD FACTORY genuine unmodified DP7112. Like new DPV5 \$28. Tocom VIP parts units \$5 each. Call 1-800-500-9825.

SA UNMODIFIED all makes and models. Call for best prices 706-398-2100.

PANASONIC TZPC145-3: the original 145 with parental control and channel 3 output. \$45 each/10 lot. With remote! All units fully guaranteed, RAN, and repacked. We are the lowest wholesaler of Panasonic equipment. Gentry Communications. 507-332-2788.

BATTERIES WHOLESALE. Heavy duty AA and AAA batteries. These are ideal for remotes, toys, and small electronics. 24 batteries per box. Cells start at 12¢ each! Fully guaranteed in factory packed boxes. Wholesalers and distributors call for case quantities. Gentry Communications. 507-332-2788.

GENUINE UNMODIFIED TOCOMS VIP. CALL 717-401-3438.

PIONEER DAYS. Factory original unmodified 10 lot. Pioneer 6110 \$65; 5130 \$50; factory genuine unmodified 99 channel Zenith \$38; factory genuine unmodified True 99 channel 550MHz; Tocom 5503 VIP \$50 replaces 5507s. 1-800-500-9825.

TOCOM UNMOD. 5503 cable converters \$6 each. Call 706-398-2100. 10 lot min.

FILTERS IN STOCK, limited supply. 110, 108.5, 106.5, 97.5 MHz notch. Round and square types. \$14 to \$20 each. Highest quality. 407-676-2530. Mention ad number F100.

ALL ELECTRONICS CORPORATION

QUALITY PARTS

FAST SHIPPING

DISCOUNT PRICING

CALL, WRITE, FAX or E-MAIL For A Free 96 Page CATALOG. Outside the U.S.A. send \$3.00 postage.

Mini-Right Angle Gearhead Motor with Control Circuit

Omron # R2DG-41 These unusual little motors have built-in control circuits that allow them to be used in a continuous or a pulsed mode. In continuous mode the final drive gear turns at 22-45 RPM (3-6 Vdc). In the pulsed mode the final drive gear turns one revolution each time the controller is momentarily pulsed. The motor assembly is 1.75" x 1.25" x 0.5" overall. The nylon final gear is 0.62 diameter and has a little nipple slightly off-center to which a small push-rod could be attached. Motors are in good condition, removed from equipment. Hook-up instructions included.



CAT # DCM-110 \$7.50 each

3000 MCD ULTRA-BRIGHT RED LED

25¢ each in 1,000 Quantities

Everlight # 383URC-2/TR1-C(R) Red, "Ultra-bright" T 1 3/4 LEDs now at our lowest price ever. Due to a special purchase of "tape-and-reel" parts we are able to offer these LEDs at an incredibly low price when purchased on the reel. These are 5 mm diameter water-clear LEDs that light bright red at 20 ma.



CAT# LED-50 100 for \$35.00 1000 for \$250.00 (25¢ each)

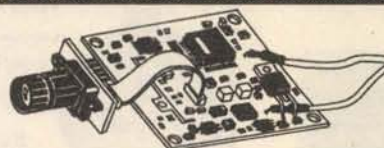
9 Volt Style Nickel-Cadmium Rechargeable Battery

Sanyo "Rechargacell"™ # N-6PT 7.2 v 120 mA battery for 9 Volt applications.



\$2.00 each CAT# NCB-91 10 for \$30.00

Our Lowest Price Ever! COLOR, VIDEO CAMERA



Get a good quality color board-level camera for less than black-and-white.

NTSC composite video output camera. Two pc board design: 8mm adjustable lens and 1/4" CCD sensor are mounted on 1.18" x 0.83" pc board. Lens length, 1.1". Control board is 2.36" x 2" x 0.6" thick. 250,000 pixels. Focus from 5 mm to infinity. 4" cable for power input. 5' cable with RCA plug for video output.

Operates on 5 Vdc, ± 5%, 180 mA max. Ready to go - includes wall transformer power supply.

CAT # VC-600 \$85.00 each

"HI-8" Video Cassette

SONY HI-8 Top quality, metal particle 120 minute video cassettes. Used for a short time, then bulk-erased. Each cassette has its own plastic storage box.



CAT # VCU-8 \$3.00 each

10 for \$28.00 • 100 for \$250.00

Piezoelectric Element

1.32 DIAMETER X 0.16"

AVX/Kyocera # KBT-33RB-2CN



Metal encased piezoelectric acoustic generator. High durability. Small, thin shape. Designed for telephone use. Inside the metal case is a 1.28" diameter piezo element with 5.5" leads attached. If you're looking for a plain element with leads, the case can be pried apart fairly easily. CAT# PE-39

100 for \$40.00 1000 for \$250.00 (25¢ each)

2 for \$1.00

ORDER TOLL FREE

1-800-826-5432

MAIL ORDERS TO: ALL ELECTRONICS CORP.

P.O. BOX 567

VAN NUYS, CA 91408-0567

FAX (818) 781-2653 • INFO (818) 904-0524

INTERNET <http://www.allcorp.com/>

E-MAIL allcorp@allcorp.com

NO MINIMUM ORDER • All Orders Can Be Charged to Visa, Mastercard, American Express or Discover • Checks and Money Orders Accepted by Mail • Orders Delivered in the State of California must include California State Sales Tax • NO C.O.D. • Shipping and Handling \$5.00 for the 48 Continental United States - ALL OTHERS including Alaska, Hawaii, P.R. and Canada Must Pay Full Shipping • Quantities Limited • Prices Subject to change without notice.

MANUFACTURERS - We Purchase EXCESS INVENTORIES... Call, Write, E-MAIL or Fax YOUR LIST.

RAW UNMODIFIED addressable converters. Major makes and models, new and refurbished. Wholesale pricing. Dealers only. Call now for best selection 702-338-3900.

CABLE CONVERTERS. Buy, sell, repair. All major makes and models. Blank PICs. 1-888-836-6060.

BOARD R US, for all your cable needs or computer software, programming service available. 4 MHz resonators 3 pins as low as \$.34. For info call 909-948-3736 or visit us at our web site <http://members.aol.com/BoardRUs>

SA UNMODIFIED all makes and models. Call for best prices 706-398-2100.

GENUINE UNMODIFIED JERROLD DPBB7312 FOR SALE 10 LOT MIN. CALL 708-715-6118.

WANTED: GENUINE RAW UNMODIFIED CABLE TV CONVERTERS. TOP CASH PAID. CALL 708-715-6118.

UNMODIFIED CABLE CONVERTERS: JERROLD, SCIENTIFIC ATLANTA, PIONEER, ZENITH, TOCOM. MIN 10 LOT. CALL 708-715-6118

ZENITH ST1000 unmodified \$16 each. Call 706-398-2100. 10 lot min.

Closing Date For Next Issue - December 5th!

TELEPHONE/FAX

BEEPER, TWO-WAY radio repairs, modifications, duplications, all models, test equipment. Call TJ 718-341-1849, Fax 718-978-4616.

TELEPHONE CATALOG of Panasonic, SWBell, VTEC and more, including alarm systems, parts, and all phone accessories. Send \$2 to HES Electronics, POB 183, Brick, NJ 08723. Mention this ad and get a \$10 certificate! Visit www.heselectronics.com

BLUE BOOK PHONE REPAIR. 1000 models answering machines, cordless, \$25. KEN's, 2825 Lake, Kalamazoo, MI 49001 616-345-4609. www.kenselectronics.com

NEW: MEMORECS system, private outgoing messages, DTMF logging, I/O control, interfaces answering machine. Oricom Technologies, 303-449-6428. www.sni.net/~oricom

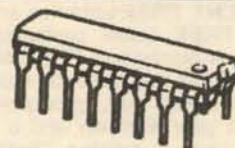
PHONE SYSTEMS WANTED!!! We buy AT&T MERLIN, SYSTEM 25/75/85 and other AT&T phone systems. Please call for a quote or fax us your equipment list. **KEYWAYS, INC.**, 937-847-2300 or FAX 937-847-2350.

WHAT! YOU don't have **TELECODE'S** NEW 1998 "HACKER CATALOG," yet! 125+ items. Call 520-726-2833. Surf online at <http://www.hackerscatalog.com>

COMPONENTS

DON LANCASTER'S ACTIVE FILTER COOKBOOK is back in print. Autographed copies of the seventeenth(!) classic printing \$28.50. **SYNERGETICS PRESS**, Box 809-N, Thatcher, AZ 85552. 520-428-4073. Visa/MC.

MILLIONS \$\$\$ in "scrap gold" from old computers and electronics junk. Message: 603-645-4776 or www.tiac.net/users/quicksand/goldtek.htm



WANTED: EXCESS ELECTRONIC INVENTORIES, ICs, MEMORY, EPROMs, PALs, LEDs, CIRCUIT BOARDS, DIODES, AND TRANSISTORS. CALL ACTIVE MICRO, 435-867-8660 OR FAX 435-867-8663.

PHOTOMULTIPLIER TUBES, radiosondes, electro-luminescent panels, electronic parts, test equipment. www.lonemtn.com

MILITARY TRANSISTORS & DIODES & INTEGRATED CIRCUITS WANTED. ELECTRONIC MATERIAL INDUSTRIES 818-769-1002, FAX 818-769-1084.

SMT COMPONENTS and complete SMT manufacturing system. Closing R&D/manufacturing company. Must sell lots of equipment. Call 1-800-869-7827 or visit www.starcom.com for list.



FACTORY SALE! CNL100, CNP101: 1/3" CCD, 430 line horiz., 12V/100mA, lens and pin hole types, lens 3.6mm/F2.0, 1.27" (W) x 1.27" (L) x 1" (H). \$43 @ 5 pcs., \$38 @ 10 pcs. Distributors welcome. Matco, Inc., 1-800-440-0299 Fax: 630-350-9546. E-Mail: sales@mat-co.com Web site www.mat-co.com

IC PULLOUTS, other components, sold cheap. Buying unused connectors, especially coaxial and "round plugs." www.ncci.net/millermetal

COMPONENTS: 74LS00B1 5¢, 74LS164P 5¢, 74LS165AN 5¢, BOURNES 500 OHM 20T pot 10¢, All parts are unused in tubes, quantity orders welcome send check or money order to Lloyd's, 27315 Jefferson Ave. Ste. J-17, Temecula, CA 92590. \$3 for postage and handling.

24 Hr. Shipping

To Order Call 1-800-292-7711 Fax: (847) 541-9904

Quality Kits for Hobbyist and Students

All Kits include PCB, all parts, and detailed assembly manuals.

XK-700 Digital / Analog Trainer

Elenco's newest advanced designed Digital / Analog Trainer is specially designed for school projects. It is built on a single PC board for maximum reliability. It includes 5 built-in power supplies, a function generator with continuously sine, triangular and square wave forms. 1560 tie point breadboard area. Tools and meter shown optional (Mounted in a professional tool case made of reinforced metal).

XK-700
Assembled and Tested
\$189.95

XK-700-SEMI KIT
w/ Fully Assembled PC Board
\$174.95

XK-700K - Kit
\$159.95



Made in the USA

Hobbyist Tool Kit TK-1000

All the tools you'll need to build these kits. 25 tools contained in a heavy-duty carrying case.

\$39.95



Call for a
FREE
64 page
catalog!
(800) 445-3201

SOLDERLESS KITS

NEW

TALKING CLOCK KIT

\$14.95 AK-220



- Dual analog/digital
- Rooster crows every hour.
- Easy-to-build
- No Soldering Required**

35mm Camera Kit

AK-540 \$14.95

Learn all about Photography

No Soldering Required



ELECTRONIC KEYBOARD KIT AK-900

\$24.95

- 37 mini-size keys
- 8 tempo rhythms
- 4 custom drums



REMOTE CONTROL CAR KIT

AK-870

- 7 functions
- Remote control included

\$24.95

No Soldering Required



Stereo Cassette Player Kit

\$14.95 AK-200

- Transparent Case
- Belt Clip
- High Resolution
- Includes Headphones



M-1005K

Digital Multimeter Kit

Low cost, 3 1/2 digit LCD, 18 ranges, transistor test, diode test, overload protection and pocket-size.

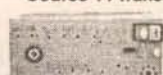
\$19.95



AM/FM-108K

AM/FM Radio Kit and Training Course 14 Transistors and 5 Diodes

\$29.95



AM Radio Kit and Training Course 7 Transistors and 1 Diode **\$19.95**

FO-30K

Fiber Optics Technology with Training Course **\$24.95**

Learn the basics of fiber optics data communications while you build this exciting kit. Comes complete with all necessary components.



Telephone Kit Model AK-700

Build this high-tech see-thru plastic telephone. Learn theory on how telephones work and then proudly show off your work with the transparent phone case. Complete with all parts and manual. Neon lamps flash when the phone rings.

\$15.95



AR-2N6K

2 meter / 6 meter Amateur Radio Kit

\$34.95



AK-300 Digital Roulette Kit

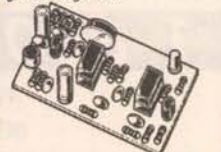
This Digital Roulette Kit is just like the real thing. With a push of a button, the LEDs spin round and round. Where they stop is anybody's guess. It's unique design includes "pop out" chips of different values. Enjoy hours of fun with this game of chance. Requires one (1) 9V battery.

\$14.95



Sound Activated Switch Model K-35

Clap and the light comes on, clap again and it goes off.



Telephone Bug Model K-35

Size of a dime, yet transmits both sides of a phone conversation to any FM radio. No battery needed.



\$7.95

Motion Detector Kit Model AK-510

Simple and fun to build. Compact, portable, and adds safety to your home or office. Requires one (1) 9V battery.



\$14.95

Guaranteed Lowest Prices

UPS SHIPPING: 48 STATES 5%
OTHERS CALL FOR DETAILS
IL Residents add 8.25% Sales Tax

C&S SALES, INC.

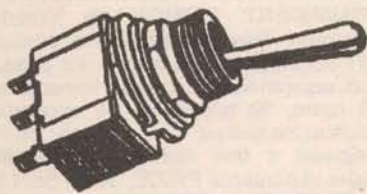
150 W. CARPENTER AVENUE
WHEELING, IL 60090
FAX: (847) 541-9904 • (847) 541-0710
http://www.elenco.com/cs_sales



**15 DAY MONEY BACK GUARANTEE
FULL FACTORY WARRANTY**

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

OLD ICs & TRANSISTORS WANTED:
HIGHEST PRICES PAID please FAX
your list with part number, quantity &
condition of any semiconductors to
Rick @ ESI, 5363 Broadway Ave.,
Cleveland, OH 44127. 216-441-8500
FAX 216-441-8503. Since 1946!
www.electronic surplus.com



AMAZING! 35¢ ALL TOGGLE SWITCHES. Brand new. Rated 6A/125V.
Hardware included. 1/4" panel hole.
SPDT or DPDT on-on, or on-off-on. Min-
imum 100pcs./package. Add \$6 freight.
Gateway Products Corporation, PO Box
936397, Margate, FL 33093, 954-974-
6864, Fax: 954-974-6818, VISAMC, no
COD.

WANT TO Buy: ICs, military & aircraft
relays, diodes, transistors, Cannon,
TRW, Amp, Burndy, Deutsch, Bendix
connectors, electronic test equipment &
most components. Hoffy Electronic Ent.,
818-718-1165, FAX 818-341-5506.

FOR SALE: Tubes galore! Send SASE
for latest list "X." TYPETRONICS, PO
Box 8873, Ft. Lauderdale, FL 33310-
8873. 954-583-1340, Fax 954-583-0777.
Fred Schmidt N4TT. WANTED: MS (mili-
tary green) connectors, and door knob
capacitors.

MICROCONTROLLERS



**PIC MICROCONTROLLER PROGRAM-
MER KIT.** Super value at \$14.95 + \$4.95
shipping. See our web site for the com-
plete range of PICs that can be pro-
grammed. Includes PCB, parts and
instructions. P16PRO shareware must
be downloaded from the web. Amazon
Electronics, tel 1-888-549-3749. Lots of
other products. <http://www.electronics123.com>

DATA ANALYZER, logger, reader for
PIC 16cxx, Atmel-89cxxx type micros.
DB9 Com2 serial port hookup. Compact
unit with software \$800. E-Mail:
picrat@themetronet.com Bluejay
Electronics, Box 9, Grand Rapids, OH
43522.



PICBOT AUTOMATION controller.
Single PCB with extensive I/O and sen-
sory for home & office automation, robot-
ics, and light industrial applications.
Includes 20MHz 8-bit RISC MCU, up to
512K SRAM & FLASH, dual H-bridge
motor drivers, dual serial COM ports,
stereo digital audio, 14 Darlington driv-
ers, 6 high-current drivers, 8 LED driv-
ers, IR remote sensor, and user pro-
totype area with 10 PIC I/O (A/D) lines
and SMT pads. Includes an object-ori-
ented stack-based interpreter that runs
applications from any text file on a PC.
Runs off any DC power source from +6V
to +24V, and connects directly to PC
COM port for easy programming and
configuration. **Single PCB solution for
mobile robot projects.** Prices from
\$199 quantity 1. Web Technology, 408-
690-9660. Fax 408-279-3211 www.webotech.com

8051 DEVELOPMENT System. \$149.
DPR Microtech 1-888-495-7655.
<http://home1.gte.net/dpryan0/index.htm>

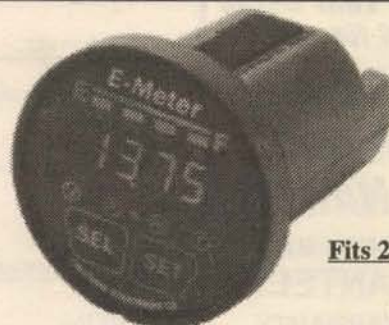
P-BRAIN microcontroller. A very com-
pact 68HC11 module that is ready to go
with EEPROM and RAM, about 1 inch
square and 1oz. in weight. [http://mem-
bers.aol.com/fuboco](http://members.aol.com/fuboco) E-Mail:
fuboco@juno.com Tel: 561-575-1487.
Future-Bot Components.

**ATMEL 90S1200/89C2051 PROTO-
TYPE BOARD.** High quality 2x3 bare
board with 1x2 prototype area. Supports
RS-232 interface, regulated power sup-
ply, connectors. Includes schematics for
board and interactive programmer. Send
check or money order for \$15.50 to:
2051BC, 1826 Lambeth Way,
Carmichael, CA 95608. 916-487-2513.
WWW.2051BC.COM

ANTIQUE ELECTRONICS

RADIO TUBES and phono. needles.
870-347-2281.

Y2K PLANNING? USING BATTERIES? GET AN *E-METER*™



From \$200

OEM's: Call for free
applications assistance.

Fits 2" hole

**Up to 1000 Amps
@500 Volts!**

Here's why *every* Y2K battery bank needs an *E-Meter* - the world's
most popular DC energy monitor: The multi-color bar graph shows
battery status at a glance. The bright digital display reports Volts, Amps,
Amp-hours, Time Remaining, - even Kilowatt-hours. Reports histori-
cal information including battery Charge Efficiency, number of dis-
charge cycles, deepest depth of discharge and average depth of dis-
charge. The optional Low Battery contact can optimize your genera-
tor run times for charging and RS232 output is available for remote
sites.

Don't be afraid of Y2K - be ready with an E-Meter!

Cruising Equipment

5245 Shilshole Ave. NW, Seattle, WA 98107
(206) 782-8100 Fax: (206) 782-4336
<http://www.cruisingequip.com>

Write in 200 on Reader Service Card.

WESTERN ELECTRIC WANTED: 1920's-1960's. Amplifiers, mixers, pre-
amps, speakers, tubes, etc. FREE
OFFER 1-800-251-5454.

CRYSTAL SETS. Parts, plans, books,
kits. Largest source in the world. Catalog
\$2. MIDCO, PO Box 222288, Hollywood,
FL 33022.

WANTED: FOR historical museum, pre-
1980 microcomputers, magazines, and
sales literature. Floyd, VA 24091-0341
(540-763-3311/540-382-2935).

WESTERN ELECTRIC WANTED: 1927-
1960S. Amplifiers, speakers, tubes, etc.
Free offer. 1-800-251-5454.

**MILITARY TRANSISTORS & DIODES &
INTEGRATED CIRCUITS WANTED.**
ELECTRONIC MATERIAL INDUS-
TRIES 818-769-1002, FAX 818-769-
1084.

**TELEGRAPHY INSTRUMENTS, KEYS
SOUNDERS, RELAYS, METERS,
VIBROPLEX'S, PRACTICE SETS,
INSTRUCTOGRAPHS, CALL BOXES,
ETC. GOODMAN 217-345-6771.**

Protect your expensive electronic equipment with quality holsters from Green Brook Electronics and the Reeline Company



GBCO-68A \$14.20
For Motorola Phones



GBCO-59 \$24.10
Fits Sony, Panasonic, and other CD Players



GBCO-70 \$14.70
For Scissors, Punch
Down Tool, Probes



GBCO-65
\$15.35
For Stun
Guns



GBCO-40A \$14.60
Fits AT&T 3610,
NEC, Nokia 100, OKI,
Uniden



GBCO-61 \$19.55
For HP HandHelds



GBCO78A \$13.70
For Nextel IDEN 1000



GBCO-52 \$12.90
Fits Palm size
organizers and
GameBoy
5"x3"x3/4"

GBCO-67A 5-1/2"x2"x1" for cell phone \$13.65
GBCO-66A 5-1/2"x2-1/8"x1-1/4" cell phone \$13.65
GBCO-45A 5-3/4"x2-1/4"x7/8" cell phone \$13.30
GBCO-28A 6-1/4"x2-1/4"x1-1/2" cell phone \$13.50
GBCO-1 clip on pliers sheath \$6.75
GBCO-2 pliers sheath for large pliers \$7.80
GBCO-32 leatherman/knife holster w/
security flap \$8.20
GBCO-47 clip on for cable jacket strippers
scissors and termination tool \$11.80
GBBL-7 belt loop holster for mini flashlight \$5.35
GBBL-9 mini-flashlight and leatherman/knife \$4.80
GBCO-3 AA Flashlight Holster \$6.45
GBCO-34 for pepper sprays \$9.15



GBCO-50 \$12.90
Fits PalmPilot,
Apple Newton



GBCO-48 \$13.25
Fits Alpha-numeric pagers



GBCO-36 \$17.80
For Magellan GPS, and other
GPS Devices



GBCO-27A \$12.98
Fits Ericsson 237, Oki 1150



GBCO-51A \$11.85
For Motorola Startac,
Qualcomm Q



GBCO-35 \$13.05
Fits Motorola
Bravo Express

**green brook
electronics**

269 U.S. Highway 22 East Green Brook, NJ 08812

We stock hundreds of holsters for phones, pagers,
hand held computers, police, EMT, tools/testers. Call us now to place
an order, or assistance in finding a holster to fit your needs.

Tel: (732) 968-3500

Fax: (732) 968-3378

Write in 71 on Reader Service Card.

Nuts & Volts Magazine/December 1998 57

**Great Gift
Idea!!**
RIPOFF!
MADE IN U.S.A.

Largest Distributor of Reeline in the Country

WHOLESALE CABLE BOXES

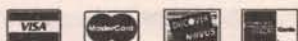
CONVERTERS • FILTERS



Call Us To
Satisfy All Of Your Cable
Equipment Needs!

**WE CARRY ALL
THE MAJOR
BRAND NAMES!**

**30 DAY MONEY BACK
GUARANTEE!
1 YEAR WARRANTY**



Call Now and Take Advantage!!!

**MODERN ELECTRONICS
1-800-906-6664**

2609 S. 156TH CIRCLE • OMAHA, NE 68130
VISIT OUR WEB SITE: <http://www.modernelectronics.com>
E-MAIL: modern@modernelectronics.com

Write in 73 on Reader Service Card.

TELETYPE MACHINES. 12 Telex model 32, 1 Telex model 35, 2 Telex model 28, 1 Siemens T100, 1 Telex model 8000, 2 Telex model 1000. Most in working condition. Best offer for the whole works, as-is, where is. Revelstoke BC. Telephone 250-837-2081

ANTIQUE RADIO CLASSIFIED. Free sample copy! Antique radio's largest-circulation monthly magazine. Old radios, TVs, ham equip., 40s & 50s radios, telegraph, books & more. Ads & articles. Free 20-word ad monthly. Subscribe today. Six-month trial: \$19.95. Yearly rates: \$39.49 (\$57.95 by 1st Class). Foreign: write. ARC, PO Box 802-G23A, Carlisle, MA 01741. Phone: 978-371-0512; Fax: 978-371-7129; Web: www.antiqueradio.com

AVIATION ELECTRONICS

BUY, SELL, trade, avionics equipment, Collins, King, Sperry: test equipment, IFR, Litton LTN series INUs. 941-625-3222 P, 941-625-0494 F, E-Mail: avio@afcon.net

SYNCHRO RESOLVER test sets, system analyzers, test equipment. www.lonemtn.com

MILITARY TRANSISTORS & DIODES & INTEGRATED CIRCUITS WANTED. **ELECTRONIC MATERIAL INDUSTRIES** 818-769-1002, FAX 818-769-1084.

ATTENTION DEALERS/DISTRIBUTORS

BUY DIRECT FROM THE MANUFACTURER

THESE AND OTHER VIDEO SECURITY PRODUCTS NOW AVAILABLE!!! (DEALERS/DIST. ONLY) Minimum Order.

	Qty 5	Qty 10	Qty 20	Qty 50+
CCD Cameras				
B&W Board	\$57	\$52	\$47	Call!
B&W Board/sound	\$62	\$57	\$52	Call!
B&W Mini	\$65	\$60	\$55	Call!
Color - Mini	\$150	\$142	\$135	Call!

*B&W CCDs use Sansone Chips. Color CCDs use Sony.

Guardian Eye

CCD Camera Hidden Inside a "Magnavox" Clock

	Qty 5	Qty 10	Qty 20	Qty 50+
CCD Clock				
B&W Wired	\$144	\$129	\$114	Call!
B&W Wireless	\$289	\$264	\$248	Call!
Color Wired	\$234	\$218	\$199	Call!
Color Wireless	\$387	\$362	\$345	Call!

Wireless use 2.4Ghz standard transmitters and receivers.

**Call ATN Today for the Best Prices and
Quality Security Products.**

American Technologies Network Corp. 1(800)910-2862
20 S. Linden Ave. #1B 1(650)875-0130
S. San Francisco, CA 94080 fax: 1(650)875-0129
www.atncorp.com sales@atncorp.com

Write in 74 on Reader Service Card.

THE CASE AGAINST PATENTS. Don Lancaster's tested and proven alternatives that work in the real world. \$28.50. Synergetics Press, 3860 West First Street, Box 809, Thatcher, AZ 85552. 520-428-4073. synergetics@tinaja.com VISA/MC.

ELECTRONIC EAVESDROPPING EQUIPMENT DESIGN by Winston Arrington. This revised edition contains 117 schematics and text of our production equipment. 29 crystal transmitters, 35 room, 32 telephone, 15 subcarrier, countermeasures and much more. Request a free detailed explanation sheet of contents. **PRICE: \$65 + S&H \$6.** **SHEFFIELD ELECTRONICS CO.,** PO Box 377940-E, Chicago, IL 60637-7940. Tel: 773-324-2196. <http://www.adnetmk.com/sheffield>

COLLECT COMPUTERS? Sure! Start now before it's too late. Buy a Guide to Collecting Computers and Computer Collections. Send \$22 (includes S&H & taxes) to Unusual Systems, 220 Samuel, Kitchener, ON N2H1R6. 519-744-2900. kstumpf@unusual.on.ca

WHAT! YOU don't have TELECODE's NEW 1998 "HACKER CATALOG," yet! 125+ items. Call 520-726-2833. Surf online at <http://www.hackerscatalog.com>

HOW WILL HIGH DEFINITION TV implementation plans affect you? Send \$5 for detailed newsletter/report. Communications Systems Labs, Dept. HDTV, 95-132 Lokih Street, Suite A, Mililani, HI 96789.

ROBOTICS



PICBOT AUTOMATION controller. Single PCB with extensive I/O and sensory for home & office automation, robotics, and light industrial applications. Includes 20MHz 8-bit RISC MCU, up to 512K SRAM & FLASH, dual H-bridge motor drivers, dual serial COM ports, stereo digital audio, 14 Darlington drivers, 6 high-current drivers, 8 LED drivers, IR remote sensor, and user prototype area with 10 PIC I/O (A/D) lines and SMT pads. Includes an object-oriented stack-based interpreter that runs applications from any text file on a PC. Runs off any DC power source from +6V to +24V, and connects directly to PC COM port for easy programming and configuration. **Single PCB solution for mobile robot projects.** Prices from \$199 quantity 1. Web Technology, 408-690-9660. Fax 408-279-3211 www.webtech.com

STEPPER MOTOR CONTROLLER: interfaces to PC parallel port, kit \$19.95, with stepper motor \$24.95, assembled and tested \$29.95, with motor \$34.95. Controls and drives unipolar stepper motors up to 50V 1 amp. Extendable stepper motor controller: controls 4 motors, extendable up to 32 motors with external cable and drivers, \$49 kit, \$69 assembled and tested. Controller boards require separate power supply, 5V@1A for logic and from 3 to 50V as required for a motor. Stepper motors available from \$1.50 to \$25. Stepper motor controller/driver ICs L297, \$4.50; A3953SB, \$4.75; PBL3717A, \$2.50; transistors etc., at low prices. Dual voltage power supply 5V@3A and 12V@1.5A, \$12. \$5 shipping and handling for orders over \$50. Ask for a brochure from The Cuthbert Group, 301-236-4063 or see our web site at www.cuthbertgroup.com

COMPUTER PARTS

www.lapazusa.com

MEMORY UPGRADES

1Mx9-70 SIMM.....	\$10
4Mx9-70 SIMM.....	\$19
1Mx32/36-70 72-pin SIMM (4MB).....	\$10/15
2Mx32/36-70 72-pin SIMM (8MB).....	\$19/25
4Mx32/36-70 72-pin SIMM (16MB).....	\$39/44
8Mx32/36-70 72-pin SIMM (32MB).....	\$65/72
64M(8x64) EDO/PC 100 DIMM.....	\$89/95

VIDEO

1MB KIT(2-256x16)2CAS SOJ/ZIP.....	\$18/35
1MB KIT(2-256x16) 2WE SOJ/ZIP.....	\$19/36

CACHE

64Kx1-15ns 22-DIP.....	\$5.50
32Kx8-25/20/15ns 28-DIP.....	\$32/22.50
64Kx8-15ns 32-DIP.....	\$6
128Kx8-15/20ns 32-DIP narrow.....	\$12 & up
128Kx8-15/20/25ns 32-DIP wide.....	\$12 & up

CPU

INTEL 486DX2-66 (5v) CPU.....	\$30
INTEL 486DX4-100 (5v) CPU.....	\$69
INTEL PENTIUM 88hz OVERDRIVE.....	\$85
INTEL PENTIUM 133/166 CPU.....	\$65/79

MISC. MOTHERBOARD KITS

486 M/B 100MHz, 256K, 16MB.....	\$95.00
PENTIUM M/B 133MHz, 512K, 32MB.....	\$195.00

* 1-year warranty on these kits

MMX ADAPTOR allows your MB to accept MMX CPU's \$30.00

AMD 486DX4-100+5v ADAPTOR+CPU FAN
This kit will allow you to upgrade your old MB to a faster CPU \$65.00

LBA CARD upgrade your hard drive beyond 540MB without the expense of upgrading your present BIOS \$29.95

PACKARD BELL

386/486 to Pentium motherboards

PRICES SUBJECT TO CHANGE WITHOUT NOTICE - TERMS: COD(CASH), VISA/MC - MINIMUM ORDER \$20 - SHIPPING & HANDLING: \$7 MIN.
ORDER LINE: (800) 586-4199

LA PAZ ELECTRONICS INT'L
P.O. BOX 261095, San Diego CA 92196
TEL (619) 586-7610 FAX (619) 586-1482
e-mail: lapazusa@pobox.com

Cable Converters

NEW
*860E, 135 channel converter with remote, ch-3 output, AFT/MFT(auto fine tuning & manual fine tuning), parental lock, HRC/STD and sleep timer

NEW
*860V, 135 channel volume control converter, with remote, ch-3/4 output, AFT/MFT, parental lock, HRC/STD and sleep timer

*550E, 85 channel converter with remote unit, ch-3 output, AFT(auto fine tuning), parental lock, HRC/STD, sleep timer

*Refurbished 85 channel plain converter with remote, ch-3 output, auto fine tuning, HRC/STD and sleep timer ----- from \$25

Call or Fax us for free brochures and price list

PCW CO/(310)515-5085, (310)538-3636(Fax)

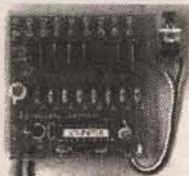
H-BRIDGE MOTOR controllers, 12VDC, 35A average, 50A peak PWM out. Forward, reverse, ramp-up and ramp-down on acceleration/deceleration. Current foldback when hot, reverse polarity protected, conformal coated, regenerative braking, compact, approx. 3.75"x5.5". \$25 & S&H. 717-735-5053. <http://members.tripod.com/~divelec>

ROBOTS, ROBOT kits, 68HC11 micro-controllers, tutorials, software, spy cameras. Ready for Christmas! <http://www.mrrobot.com> 804-272-5752, 1-888-Mr-Robot.

CNC SYSTEMS! Write: motivity, Attn. Pam, PO Box 428, Rocklin, CA 95677. Call: 916-349-8757. Info/pictures at www.motivityusa.com A great place to buy CNC.

PLANS — KITS — SCHEMATICS

HOBBY CATALOG: Broadcasting and microbroadcasting transmitters, amplifiers, antennas. **Start your own radio station books.** Audio, TV, ham, CB, surveillance, science projects, and more. **PAN-COM** International, Box 130-V, Paradise, CA 95967. www.panaxis.com



RUNNING LIGHTS KIT. Ideal for Christmas decorations etc. 8 LEDs switch on in 10 push button selectable patterns. 8 speed levels for a total of 80 combinations. Includes PCB, parts and instructions. \$14.95 + \$4.95 shipping. Can operate light bulbs with 8x TRIACs (\$6 extra). Amazon Electronics, tel 1-888-549-3749. Lots of other products. <http://www.electronics123.com>

ELECTRONIC KITS, projects and supplies for prototyping, designing or hobby. Call 1-888-GO-4-KITS for catalogs or send \$3 to Quality Kits, 49 McMichael St., Kingston, ON., K7M 1M8. <http://www.qkits.com>

TEST EQUIPMENT kits. If you liked Heathkit, you will love Technology Systems, 4 Prospect Pl., Torrington, CT 06790.

HEATHKIT COMPANY is selling photocopies of most Heathkit manuals. Only authorized source for copyright manuals. Phone: 616-925-5899, 8-4 ET.



BROADCAST FARTHER! 75-110MHz amplifier connects to stereo transmitters. Produces 2-15 watts. Requires 50-150mW drive. Complete plans with part source and antenna information only \$14 + \$2 S&H. **Progressive Concepts**, PO Box 586, Streamwood, IL 60107. 630-736-9822.

BUILD THE MENDOCINO MOTOR. This fascinating device is a solar powered, magnetically levitated motor. It will delight and amaze you and your friends. The 27 page plans book includes a list of parts suppliers. The motor uses readily available parts. Plans are \$15 plus \$2.50 S&H. Write to: St. Elmo's Fire, PO Box 141, Stow, MA 01775. E-Mail: tcv@genrad.com

AWESOME KITS: voice changers, levitators, lasers, solar robots, and more! Catalog \$1. **LNS Technologies**, PO Box 67243, Scotts Valley, CA 95067. www.ccnet.com/~lnstech

200+ ELECTRONICS PROJECTS. Build for pleasure or make 100% (or more) profits reselling printed plans. \$1 (refundable) for catalog & dealer info. **MATCO-A5**, PO Box 509, ROSEVILLE, MI 48066-0509.



CIRCUIT BOARDS. Totally new! Low cost, precision-made PC boards from your Gerber/NC Drill files. Single and double sided. Full details at <http://www.pcbmilling.com> E-Mail: feedback@pcbmilling.com FAX: 703-818-0071.

DAZZLING HOLIDAY LIGHT DISPLAY. Build a spectacular light show for the holidays driven to the tempo of your favorite music. Plans for a state-of-the-art color organ \$15. Call Communications Systems Labs at 1-800-529-9483 or check our web site at www.commsyslabs.com for this and more.

MATCH BOOK sized FM wireless mic kit, surface mount, color enclosure included. Details: www.Nmart.com or send \$9.50 check/M/O plus \$0.50 S&H to Anders Corp., 104 Gray St., Paterson, NJ 07501. Satisfaction guaranteed.



TERRIFIC TIMEPIECES! LED binary clock. LED digital clocks, other kits! Free catalog! WPC, 805-339-0702. www.west.net/~wpc

ADVANCED TECHNOLOGY: Antigravity, free-energy, time-travel, alternative fuels, psionics, space-age weapons, lasers, ultrasonics, strange-science, bionics, high-voltage, robotics, surveillance, electronic test equipment, and more. Plans, schematics, kits. \$3 for catalog: Future Horizons, Dept-N, PO Box 125, Marquette, MI 49855. <http://www.futurehorizons.net/energy/>

HOME PAGE:
www.hamboree.org



E-MAIL:
edg@elink.net
wd4sfg@bellsouth.net

ARRL HAMFEST OF THE AMERICAS & 39TH ANNUAL TROPICAL HAMBOREE® AMATEUR RADIO & COMPUTER SHOW

FEBRUARY 6-7, 1999

FAIR EXPO CENTER
S.W. 112 AVENUE & CORAL WAY (S.W. 24 ST.)
MIAMI, FLORIDA



TALK IN:
146.995, 146.76
444.595
Information Loop:
147.555

INTRODUCTION TO AMATEUR RADIO DISPLAY • VHF TRANSMITTER HUNT • TECH TALKS ON APRS
ANTENNAS • DXPEDITIONS • AMATEUR SATELLITES • YOUTH FORUM • ARRL FORUM
DX FORUM • COMMERCIAL EXHIBITS • 900+ SWAP TABLES • ON-SITE EXAM SESSIONS
FIELD CHECKING FOR DXCC AND CQ AWARDS
ALTERNATIVE INTEREST PROGRAMS AND DEMONSTRATIONS
NUMEROUS "FREE AWARDS" PLEASING TO ALL

NEW FOR 1999

COMPUTER SEMINARS AND DEMONSTRATIONS
HINTS ON "BASIC COMPUTER MAINTENANCE" • "GETTING CAUGHT BY THE INTERNET" AND MORE

AIR-CONDITIONED FACILITY • ON-SITE CAMPING FOR 300 RV'S
FREE PARKING FOR 15,000 VEHICLES • WHEELCHAIR & STROLLER RENTALS
ON-SITE REFRESHMENT AREAS • ATM IN MAIN BUILDING FOR THOSE "SPECIAL SALE PURCHASES"

Registration: \$5.00 Advance (deadline Feb. 5th) — Door: \$7.00, Tax included
Campsites: 3 days (Fri., Sat., Sun.) \$54.00 • 4 days (Thur., Fri., Sat., Sun.) \$72.00
Check out with Camp Committee by 5:00 P.M. Sunday for mail refund of Sunday fee.
Exhibit Fees for Two Days of Show
10' x 10' Booth: \$250.00, includes company sign, power, undraped tables, chairs & tickets
Additional booths: \$200.00 per 10' space
Area "C" Tables: \$60.00 per draped table (min. 4 tables), includes power & tickets
Swap Shops "A and B": \$33.00 per table plus power @ \$10.00 per user & tickets.
Telephone lines to booths or tables @ \$115.00 per line.
(Request exhibit reservation form by e-mail, fax or postal mail prior to sending payment)

HEADQUARTERS HOTEL: AIRPORT FAIRFIELD INN SOUTH: \$72.00 single, double + 12.5% tax
Location: Marriott Complex, 1201 N.W. LeJuene Road (N.W. 42 Ave.)
Telephone: 800-228-2800 (Only 100 rooms available at special rate)
Mention "Tropical Hamboree" • Cutoff date is January 15, 1999

CHECKS AND/OR MONEY ORDERS FOR TICKET, CAMP, EXHIBIT FEES SHOULD BE
PAYABLE TO DADE RADIO CLUB OF MIAMI, INC.

Mail to: Evelyn Gauzens, W4WYR, 2780 N.W. 3 St., Miami, FL 33125-5059
BOOTH & TABLE INQUIRIES: Email: edg@elink.net, Tel: 305-642-4139, Fax: 305-642-1648
wd4sfg@bellsouth.net, Tel: 305-226-5346

⇒ CHECK OUT OUR HOMEPAGE: www.hamboree.org ⇐

Write in 77 on Reader Service Card.

Subscribe to Nuts & Volts and be automatically entered in our monthly prize drawing!!



P.S. Technology

Tel: (800) 326-8103 Fax: (800) 878-7083



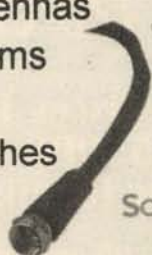
PLUG IN

- ◆ IC's & Semiconductors
- ◆ Telephone & Cellular Accessories
- ◆ Amplifiers & Audio Equipment
- ◆ 35mm Cameras
- ◆ Universal Remote Controls
- ◆ Batteries (all brands)

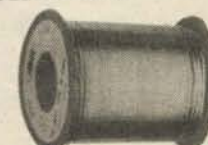
- ◆ Computer Products
- ◆ Recordable CD's & Tapes (top brands)
- ◆ Indoor TV Antennas
- ◆ Security Systems
- ◆ CB Radios
- ◆ Fuses & Switches



SP/ST-P



SOLDER ROLL



Write in 78 on Reader Service Card.

Nuts & Volts Magazine/December 1998 59



REFILL INKS FOR INKJET PRINTERS

Refill your old cartridge and save. All refill kits come with instructions and needed materials for refilling inkjet cartridges. Success guaranteed. Available for the following:

CANON BC-01, BC-02 CANON BJ10e, APPLE STYLEWRITER, BJ-200 Single Black Refill \$8.00; Triple Refill \$19.00. **CANON BJC-600** (BC-201) Single Black or Single Colors (3 refills) \$8.00. **CANON BJ-130/300/330 & IBM Exec Jet** (Cart #BJL-481 & BJL-642) Black - 3-bottle kit \$22.00. **CANON BJC-210/240** (BC-05 Cart) 3-color kit (3 refills each color for BC-05) \$24.00. **CANON BJC-4000** and Apple Stylewriter 2400 Black 3-bottle kit (3 refills BC-20, 9 refills BCI-21 black, 30 refills BCI-11 black, 10 refills BCI-10) \$19.00. **CANON BJC-4000/BJC70** and Apple Stylewriter 2400 Tri-color kit - 6 refills each color for BCI-21 or 15 refills each color for BCI-11 \$24.00. **CANON BJC-800/820/880** 3-bottle kit (for BJL-643B) \$19.00. **CANON BJC-800/820/880** 3-bottle tri-color kit (Cart #BJL-643CMY) \$24.00. **EPSON STYLUS COLOR PRINTER** - (Cart S020034) Single Triple black \$19.00; Tri-color kit (Cart S020036) 2 refills each color \$24.00. **EPSON STYLUS COLOR II** - (S020047) Triple Black \$19.00 (S020049). Tri-color (2 refills each color) \$24.00. **EPSON STYLUS COLOR 400, 500, & 600** (S020093) Triple black (7 refills total) \$19.00; **EPSON STYLUS COLOR 200, 500** (S020097) Tri-color 3 refills each color \$24.00. **EPSON STYLUS COLOR 400, 600, 800, 1520** Tri-color (S020089) 3 refills each color \$24.00. **EPSON STYLUS 800/1000** (S020025) 3-refill kit, black, \$19.00. **HP DESKJET 500/550/560** (51608A, 51633A, 51626A) Black single refills \$8.00. **HP DESKJET 500/550/560**. Black 3-bottle kit \$19.00. **HP DESKJET 500C/550C/560C**. Tri-color kit (5 refills each color) \$24.00. **HP DESKJET 1200C, DESIGNJET 650** (Cart #HP 51640B) Black Three pack (3 refills) \$19.00. **HP DESKJET 1200C/1600C, DESIGNJET 650** (Cart #HP 51640 C,M,Y). Tri-color kit (one refill each color) \$24.00. **HP DESKJET 600/660** (HP 51629A) Black three pack \$19.00. **HP DESKJET 600C/660C**. (HP 51649A) Tri-color (5 refills each color) \$24.00. **HP DESKJET 855C/1600C** (HP 51645A) Black three pack \$19.00. **HP DESKJET 855C** (HP 51641A) Tri-color kit (2 refills each color) \$24.00. **HP DESKJET 720, 722, 890, OFFICE JET 1170 & 1175** (C1823A) Tri-color kit (2 refills each color) \$24.00. **HP PAINTJET** and **PAINTJET XL** (51606A) Black 3-bottle kit \$19.00. **HP PAINTJET** and **PAINTJET XL** (51606C) Tri-color kit \$24.00. **HP PAINTJET XL300** (C1645A & C1656A) Black 3-refill kit \$19.00. **HP PAINTJET XL300** Tri-color kit (1 refill each color) HP 51639C,M,Y \$24.00. **HP THINKJET, QUIETJET, KODAK DICONIX 150** (51604A or 92261A) black 5 refills \$9.00. **IBM/Lexmark/Execjet/4076** (1380620) black 3-refill kit \$19.00. **IBM/Lexmark ExecJet IIC, WinWriter 150 C** (Cart #1380619) 4 refills each color \$24.00. **SNAP AND FILL SYSTEM** - Permits refilling HP 51626A (black for HP 500-series) and HP 51629A (black for HP 600-series) cartridges without making a hole in the cartridge. Consists of special cartridge holder, syringe, plastic tubing, and directions. **STARTER KIT** - with ink for 3 refills \$28.00. **EXTRA INK FOR SNAP & FILL SYSTEM** (black only) 4-oz. bottle \$18.00; 8-oz. bottle \$34.00. Specify whether for HP 51626A or HP 51629A.

HARD-TO-GET PRINTER RIBBONS

Gorilla Banana, Commodore 1525 \$8.00; Adam Coleco \$12.00; TI-850/855 \$6.00; Centronics 700 Zip Pack \$5.00; C. Itoh Prowriter Jr., Riteman C+/F+ \$6.00; Riteman Infomunner \$8.00; Commodore MPS-801 \$5.00; MPS-803 \$7.00; Decwriter LA30/36 \$4.00; Apple Scribe \$4.00; Mannisman Tally Spirit 80, Commodore 1526 \$5.00; Epson JX-80 4-Color \$14.00; Printronix P-1013 \$11.00; Star SJ144 color 3-pack \$29.00.

ALSO HEAT & TRANSFER RIBBONS AND PAPER FOR PRINTING T-SHIRTS.

Over 300 different ribbons in stock. All ribbons new, not re-inked. Fully guaranteed.

Order directly or send SASE for complete list.

Add \$4.00 per order shipping. California residents add 7.75% sales tax.

On ribbon orders over \$50.00 deduct 10% discount.

H.T. ORR Computer Supplies

249 Juanita Way, Placentia, CA 92870-2216

714-528-9822 • 800-377-2023 • FAX 714-993-6216

<http://www.extremeplay.com/occomp/orr.htm>

Write In 79 on Reader Service Card.

TIMELESS PRODUCTS

The Best Prices and Service • In Business over 15 years!

Phone 218-346-6660 Fax 218-346-6664

CABLE TV CONVERTERS

WILL NOT DECODE

New! "TP 125 V"
128 Channel Converter with Volume

Special Prices for
TP1550PC
Call for Details

Panasonic still available!

• REFURBISHED CONVERTERS ALSO AVAILABLE •

• QUALITY REPAIR DEPARTMENT FOR ALL YOUR
TUNER REPAIRS •

• REMOTES AVAILABLE FOR MOST CABLE BOXES •

DEALERS ONLY • GREAT QUANTITY PRICES • NO DECODER SALES

Write In 80 on Reader Service Card.

Professional 10 HOUR RECORDER

Factory Direct

"BUILT LIKE A BATTLESHIP"



• Heavy duty commercial recorder - NOT improvised from consumer models

• 12, 14, and 16 hour models also available

• BUILT-IN voice activation (add \$30)

• Applications information included

• Dimensions: 11.5 x 7.0 x 2.75"

SPECIAL
Nuts & Volts
Price..

\$159

COD's OK. Sorry, no credit cards. Free catalog USA only; other countries \$5. Price includes UPS to 48 States on Pre-Paid Orders

Viking International

150 Executive Park Blvd. #4600 San Francisco, CA 94134

Phone: (415) 468-2066 • Fax: (415) 468-2067 • Web: www.vikingint.com

Write In 81 on Reader Service Card.

SURVEILLANCE TRANSMITTER SCHEMATICS! FM band- 2 telephone and 3 room transmitters constructed using Radio Shack parts with their numbers given. One telephone and two room transmitters are tunable from 65 to 305MHz, and constructed with listed supply house parts. PC board patterns presented. **PRICE:** \$25 + S&H \$2. For immediate shipment, pay with money order. **SHEFFIELD ELECTRONICS CO.**, PO Box 377940-E, Chicago, IL 60637-7940. Tel: 773-324-2196. <http://www.adnetmk.com/sheffield>

MOD CHIPS for Sony PlayStation. Now your backups will work. Only \$9.95 ea. + \$3 shipping. Call 1-888-467-6150, all major credit cards accepted. Computers & components at wholesale prices. www.cconusa.com

MILITARY COMPONENTS wanted. Capacitors, resistors, diodes, transistors, semiconductors, ICs. Electronic Material Industries, 818-769-1002, FAX: 818-769-1084.

RAPID CONSTRUCTION protoboards, kits, PIC monitor chips, pocket test-bench, telephone electronics. Oricom Technologies, 303-449-6428, www.sni.net/~oricom.

MYSTERY CIRCUITS THAT WORK! Challenging educational, simple technology. #10 SASE to J.H. Hughes, 445A Texas St. NE, Albuquerque, NM 87108-2395.



SOLDERLESS BREADBOARD SB-147: 3260 tie points, 4 binding posts. \$29.95 plus \$2.60 (2% of subtotal plus \$2) UPS ground delivery. Call 972-242-8087 for 10+ prices. Mail check to: CTI, 1301 West Beltline #105, Carrollton, TX 75006.

MANUALS — SCHEMATICS WANTED

MILITARY COMPONENTS wanted. Capacitors, resistors, diodes, transistors, semiconductors, ICs. Electronic Material Industries, 818-769-1002, FAX: 818-769-1084.

CASH FOR your test equipment manuals in good condition for most Tektronix, HP, Fluke, and other test equipment. E-Mail your list and best price to: manu_als@ionemtn.com

MISCELLANEOUS ELECTRONICS FOR SALE

MILITARY TRANSISTORS & DIODES & INTEGRATED CIRCUITS WANTED. ELECTRONIC MATERIAL INDUSTRIES 818-769-1002, FAX 818-769-1084.



SOLAR-POWERED FAN HAT. Baseball type hat with solar powered fan. Great for sports fans, golfers, etc. Available in red or blue. \$19 plus \$2.00 shipping. CA residents add 7.75% sales tax. Visa/MC/Disc/Amex OK. H.T. Orr Computer Supplies, 249 Juanita Way, Placentia, CA 92670. 714-528-9822, 1-800-377-2023, FAX 714-993-6216.

FOR SALE: Video tubes 13" to 32", even big radio, TV, & linear tubes. Hard-to-find TV parts, keypads, ICs, etc. Write to: 1418 Hwy. 199 S., East Dublin, GA 31027 or call 912-272-6561.

HIGH QUALITY TOOLS AND STAINLESS STEEL HARDWARE. European and American screwdrivers, nut-drivers, pliers, hex- keys, balldrivers, and more! Wiha, Bondhus, and Knipex. Stainless cap screws, machine screws, nuts, washers, U-bolts, and eyes. Free catalog. Robert Mink Import-Export, Box 6437V, Fair Haven, NJ 07704. Telephone or fax 732-758-8388. E-Mail: w2tv@csi.com

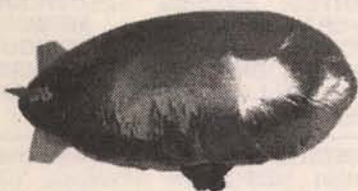
CALL FOR a free electronics catalog or visit our web site at www.bgmicro.com/ B.G. Micro, PO Box 280298, Dallas, TX 75228. Order line 1-800-276-2206.



ANAHEIM WIRE PRODUCTS. DISTRIBUTOR OF ELECTRICAL WIRE AND CABLE since 1973. Items available from our stock: Hook up wire, Automotive primary wire, GXL, SXL, Plenum cable, Teflon wire, Multi-conductor cable, Irradiated PVC, SO-CORD, Mil-Spec wire, Building wire, Welding cable, Battery cable, Telephone wire, Shrink tubing, Cable ties, Connectors cut & strip to spec. If interested, please call 1-800-626-7540, FAX: 714-771-5043. Visa/MC/Amex. SEE US ON THE INTERNET: <http://www.anaheimwire.com> OR E-Mail: info@anaheimwire.com

<http://www.pccables.com> **PC CABLES and PARTS.** 100s of hard-to-find new cables and parts. Free technical information, low prices, fast online ordering & browsing.

L BAND quadrifilar T/R antenna, 55 dB LNA, 20 watt HPA, works great for remote GPS. Info at afstar.com.



INDOOR R/C BLIMP. This blimp is operated by twin turbo fan unit propulsion system designed with built-in receiver and a handheld transmitter. Available in 4 frequencies. Batteries included **READY TO FLY.** \$89.95. West Coast Blimps, 713 Cottonwood Dr., Ridgecrest, CA 93555. 760-375-2108 <http://www.indoorblimps.com>

SMT MANUFACTURING equipment. components, digital, analog, & RF test equipment. 26 KVA generator. Closing R&D/manufacturing company. Must sell lots of equipment. Call 1-800-869-7827 or visit www.starcom.com for list.

FREE FLYER on cable TV, phones, credit cards info, schematics, project boards, other misc. items. Bill 1-800-879-9657.

NUCLEAR ELECTRONICS (NIM, CAMAC), PMTs, optics, high vacuum, and high voltage components and equipment. Guaranteed quality at reasonable cost. OE Technologies, Box 703, La Madera, NM 87539. Ph: 505-583-2482, Fax: 505-583-9190, E-Mail: oetech@newmexico.com <http://www.oetech.com>

NEW, USED, and "as is" Radio Shack items. Software, printers, computers, books, parts for R/C cars, etc. Free list. B and B Enterprises, 208 S. Pulaski St., Baltimore, MD 21223. 410-566-5388.

LCD DISPLAYS, graphics 240x128 or 40 char. by 16 lines, Toshiba TLX-1301V-30L, built-in controller and RAM, optional backlight included. Directly connects to any 8 bit data bus. Full docs. New surplus, \$59 ea. 650-244-9438, sales@equiptek.com

FOR SALE: (E)EPROM, PIC, 874x, 8751, PAL, GAL, PLD, DC motor, stepper, LCD and many other new and used electronics components. Call 425-489-9042, E-Mail: esreng@jps.net

ELECTRONICS PARTS: BELOW WHOLESALE PRICES! Phone, fax, E-Mail for free flyer. Hoffman Industries, 853 Dundee Ave., Elgin, IL 60120. Ph: 847-622-8201, Fax: 847-622-8202, toll free: 1-888-311-4248, E-Mail: hoffind@aol.com Web site & on-line catalog: <http://hoffind.com>

MISCELLANEOUS ELECTRONICS WANTED

MILITARY TRANSISTORS & DIODES & INTEGRATED CIRCUITS WANTED. ELECTRONIC MATERIAL INDUSTRIES 818-769-1002, FAX 818-769-1084.

TESTERS WANTED: Immediate offers made for Ultrasonic, Magnetic Particle, Eddy Current, X-Ray and Borescopes, 24hrs. Leave detailed message with make/model. 1-800-530-3371.

WANTED: ELECTRON tubes, ICs, semi-conductors. Summit, PO Box 1850, Linden, NJ 07036. Call 1-800-526-4052.

WE BUY your electronic excess inventories. ICs, caps, transistors, LED, connectors, PCBs, computers and related products. Call Tom Freeman 714-558-8813, fax 714-558-1603.

WANTED: TUBE HiFi/commercial amps, preamps, corner/horn speakers. Altec, Marantz, McIntosh, Western Electric, etc. 405-737-3312 fax 405-737-3355.

WANT USED or surplus DC motor controls or adjustable frequency AC drives, 1/2 HP and up. DC motors fractional to 3 HP. C. Woodruff, 5507 55th Ave. S., Seattle, WA 98118. Voice/Fax 206-723-8487.

OLD ICs & TRANSISTORS WANTED: HIGHEST PRICES PAID please FAX your list with part number, quantity & condition of any semiconductors to Rick @ ESI, 5363 Broadway Ave., Cleveland, OH 44127. 216-441-8500 FAX 216-441-8503. Since 1946! www.electronic surplus.com

SUMMER SPECIALS

MOTHERBOARDS WITH CPU:

K6 233 Mhz MMX w/ CPU	\$159
K6 266 Mhz MMX w/ CPU	\$169
K6 300 Mhz MMX w/ CPU	\$189
K6-2 300 Mhz MMX w/ CPU	\$239
K6-2 333 Mhz MMX w/ CPU	\$279
K6-2 350 Mhz MMX w/ CPU	\$369
Pentium II 266 MMX w/ CPU	\$319
Pentium II 300 MMX w/ CPU	\$379
Pentium II 333 MMX w/ CPU	\$399
Pentium II 350 MMX w/ CPU	\$469
Pentium II 400 MMX w/ CPU	\$646
Pentium II 450 MMX w/ CPU	\$895

32MB MEM

\$39.95

24X CD ROM..\$39

32/36ROM..\$49/55

24X Bundle

\$69

32X Speed CD
16 Bit Sound Card
with Wavetable.
Amplified Speakers 80W

Orders & Price

Tel: (800) 899 6430

Fax: (209) 549 8576

Buy with
confidence
Risk Free
30 Days
Money Back

WE ALSO
CARRY
COMPLETE
SYSTEMS

Printer
Memory

For ALL kinds of Drives, Sound Cards
Speakers and CD Titles: \$Call

FLOPPY DRIVES

1.44 Mitsumi.....	\$18
1.44 Teac.....	\$21

MONITORS

14" 28 108 N-I, Low Radiation.....	\$125
15" 28 1024x768 N-I, Low Rad.....	\$135
17" 28 1280x1024 N-I, Low Rad.....	\$239

KEYBOARDS

104 Keyboard.....	\$10.95
Keytronic.....	\$23
Focus 2000.....	\$Call

VGA CARDS

SVGA 1MB ISA.....	\$32
PCI 1MB/2MB/4MB.....	\$25/\$35/\$59
PCI OR AGP 4MB...TV OUT. OPTI.....	\$35
PCI OR AGP VGA 8MB.....	\$99
MATROX, ATI, DIAMOND.....	\$CALL
SVGA CARDS WITH VRAM.....	\$CALL
ANY OTHER VGA CARDS.....	\$CALL

CONTROLLER CARDS

I/O 2S, 1P & 1G.....	\$12
----------------------	------

MODEM/ FAX MODEM

33.6K Voice Modem/ Fax Modem.....	\$37
56K Voice Modem/ Fax Modem.V90.....	\$45
US ROBOTIC 56K Modem.....V90.....	\$99
ISDN.....	\$CALL

CASES WITH POWER SUPPLIES

DESKTOP CASE PREMIUM.....	\$35
MED TOWER CASE PREMIUM.....	\$35
FULL TOWER CASE PREMIUM.....	\$75
ATX MED TOWER CASE PREMI.....	\$59

HARD DRIVES SPECIALS

2.1GB..\$119	3.5GB..\$119	4.3GB..\$129
6.4GB..\$159	8.4GB..\$199	11GB..\$CALL

IBM 6X86

300 MMX
Motherboard
CPU,VGA & SOUND

\$175

All Systems carry
3 years Parts &
5 years Labour
Warranty.
Lifetime Tech
Support

EVERYDAY
LOW PRICES

www.bisme.com

BISME COMPUTERS OUTLET 906 N Carpenter Rd. Suite A. Modesto, CA 95351

Write in 82 on Reader Service Card.

Write in 83 on Reader Service Card.

Network Service Tool Set

Popular installation and service tools for networks, modems and telephones. All hand tools are professional heavy duty type.

Use the compact tester on 10BASE-T (UTP & STP), thin Ethernet (BNC), 8-position Token Ring, AT&T 258A and EIA/TIA 568A/B. Automatically scans cables for continuity, wiring sequence and polarization. Tests STP cable ground. Testing installed cables is easy with Remote Terminator and gender changers (UTP and BNC). 9V battery included.

- Coax Stripping Tool, RG-58 & RG-59
- BNC Crimping Tool, RG-58 & RG-59
- Modular Cutting/Stripping/Crimping Tool (4, 6 & 8-Position)
- Multi-Network Cable Tester
- AC Receptacle Tester
- Cable Cutter

Order No. 55625 \$197.00



PC Service Tool Set

Contains all tools needed to troubleshoot & service IBM-compatible PCs. Set includes:

- AMI Diagnostic Software
- POST Card
- Logic Probe
- Digital Multi-Meter
- AC Receptacle Tester
- Serial Adapter
- Serial & Parallel Loopback Connectors
- DIP IC Puller
- PLCC IC Puller
- Grounding Wrist Strap
- Key Top Puller

Order No. 55000 \$198.00



PC Diagnostic Tool Set

- AMI Diagnostic Software
- POST Card

Order No. 55555 \$89.00

Network Installation Tool Set

- Network Tool Set 55625 without the Multi-Network Cable Tester.

Order No. 55600 \$99.00

Call for your FREE Catalog

Graymark®

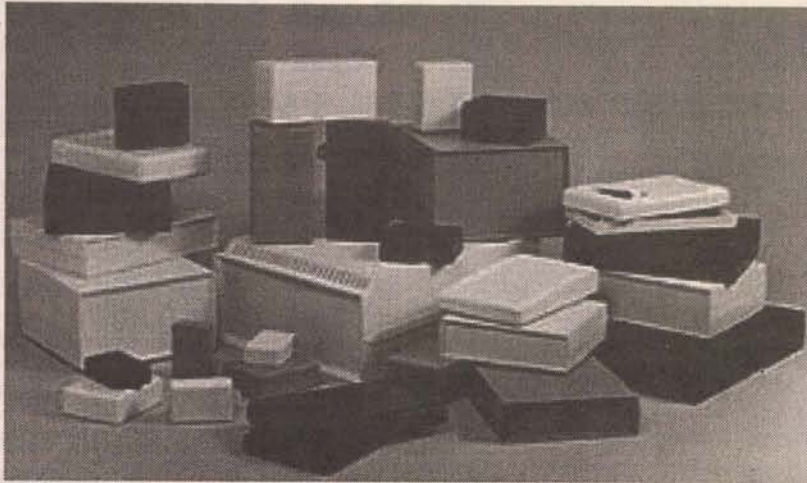
P.O. Box 2015 Tustin, CA 92781
<http://www.labvolt.com>

CALL TODAY!

800-854-7393



"Let Us Cover Your Parts!"



- Eye-Catching Enclosures
- Exceptional Value
- Massive Inventory
- Custom Machining
- Quality Silkscreening
- EMI/RFI Shielding
- Over 50 Sizes

Call, Fax, or Visit On-Line for a
FREE Catalog
email: simco@simcobox.com



SIMCO



(800) 780-9090 www.simcobox.com FAX (941) 452-6200

Write in 84 on Reader Service Card.



ALL.TV.INC.
"Our Name Says It All"

Call Us for ALL Your Cable Needs
Large Inventory of Major Brands
We will beat ALL competitor's prices

Also serving Puerto Rico

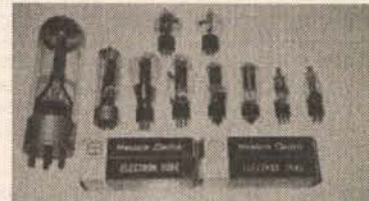
In Stock 85 Channel HRC ST - VIEWSTAR
In Stock 125 Channel HRC ST Volume
In Stock Panasonic TZ-PC175DG2

E-Mail - alltv@icanect.net

**VISA / MC
ACCEPTED**

TOLL FREE 1-800-510-1924

WANTED: TUBES, radios, transmitters, receivers, gyros, bearings, connectors, relays, lamps, synchros. Hyness Company, 709B Delair Road, Cranbury, NJ 08512-4212. Phone: 609-395-1116, FAX 609-395-1117.



HIGHEST PRICES paid for Western Electric tubes, new and used. Call Don Singerhouse/Singerhouse Sound. Toll free 1-888-715-tube.

WANTED: BALANCING machines & vibration analyzing equipment manufactured by the following: Spectral Dynamics, Hofmann, Bentley Nevada, Schenck, IRD Mechanalysis, Gishott. Contact Mike Park at E.T. Balancing, 12823 Athens Way, Los Angeles, CA 90061. 310-538-9738, FAX: 310-538-8273.

RADAR/MICROWAVE equip: Aviation, marine, fire control. Like TPS 21, APS 10, 42 APG 30. Parts, TM's, etc. Radar, Box 10215, Pittsburgh, PA 15232.

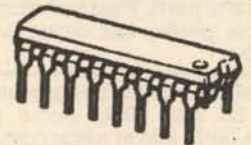
Sell Nuts & Volts

in your store and earn \$\$\$!

Contact us for details. 909-371-8497
E-Mail distributors@nutsvolts.com

WANTED: AVIONICS test equipment, IFR, 600A, 401L, others, Collins, King, Sperry, North Atlantic, Litton INUs LTN series, rate and tilt tables, air data test sets, 941-625-3222 P, 941-625-0494 F, E-Mail: avionics@afcon.net

DEC EQUIPMENT WANTED!!! We are buying DEC systems, boards, terminals, drives and peripherals. Also Scientific Micro Systems (SMS), DSD, Datability, Dialog, other DEC compatibles, and Computer Output Microfilm (COM) units. Please call for a quote or fax us your equipment list. We buy, sell, and trade. **KEYWAYS, INC.**, 937-847-2300 OR fax 937-847-2350.

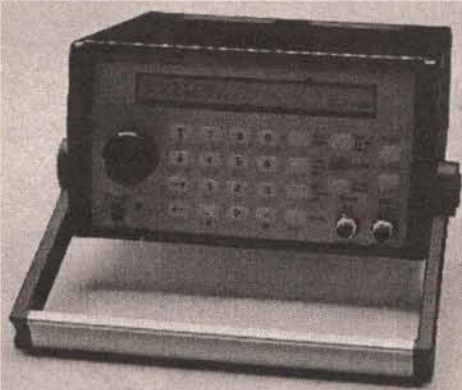


WANTED: EXCESS ELECTRONIC INVENTORIES, ICs, MEMORY, EPROMs, PALS, LEDs, CIRCUIT BOARDS, DIODES, AND TRANSISTORS. CALL ACTIVE MICRO, 435-867-8660 OR FAX 435-867-8663.

WESTERN ELECTRIC audio equipment wanted. 1927-1960's. Amplifiers, "pre-amps," speakers, transformers, tubes, etc. 1-800-251-5454.

WESTERN ELECTRIC WANTED: 1920's-1960's. Amplifiers, mixers, pre-amps, speakers, tubes, etc. FREE OFFER 1-800-251-5454.

Any waveform you want!



Telulex Inc. model SG-100A

New Features:

- ✓ 21.5 MHz
- ✓ .01 Hz steps
- ✓ multi-unit phaselock

Telulex Inc.

● **Synthesized Signal Generator**

Clean sinewaves DC-21.5 MHz with .001% accuracy!
.01 Hz steps. DC Offset. RS232 remote control.

● **Arbitrary Waveform Generator**

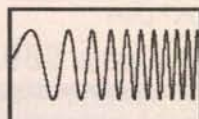
40 Megasamples/Second. 32,768 points. 12 bit DAC

● **Function Generator**

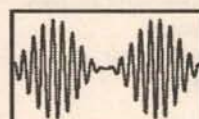
Ramps, Triangles, Exponentials, Noise & more.
0 to 2 MHz in 1 Hz steps. Continuous or Triggered.

● **Pulse Generator**

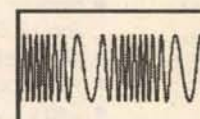
Digital waveforms with adjustable duty cycle



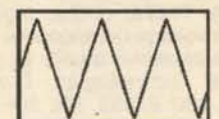
DC to 21.5 MHz linear and log sweeps



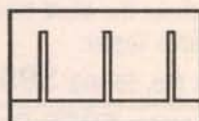
Int/Ext AM, SSB, Dualtone Gen.



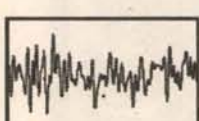
Int/Ext FM, PM, BPSK, Burst



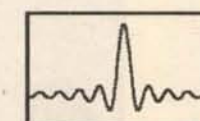
Ramps, Triangles, Exponentials



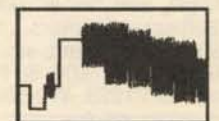
Pulse Generator



Noise



Arbitrary Waveforms



Unlimited Possibilities!

2455 Old Middlefield Way S
Mountain View, CA 94043

Tel (650) 938-0240

Fax (650) 938-0241

<http://www.Telulex.com>

Email: sales@Telulex.com

WANTED: ELECTRONIC estates. Ham, broadcasting, military, test, public address, tubes, transformers, telex equipment. The bigger the pile, the more worthwhile. We fly anywhere. Sumner McDanel 1-800-251-5454.

BBS & ONLINE SERVICES

VISIT DON Lancaster's GURU'S LAIR website at <http://www.tinaja.com> PICs, pseudoscience, PostScript, patents, Tinaja quests, flutterwumpers, book-on-demand, magic sinewaves, money machines, Navicubes, tramways, wavelets, and Webmastering. Online reprints, consultants net, forums, annotated hot links, surplus bargains, great heaping bunches more.

MOD CHIPS for Sony PlayStation. Now your backups will work. Only \$9.95 ea. + \$3 shipping. Call 1-888-467-6150, all major credit cards accepted. Computers & components at wholesale prices. www.cconusa.com

EDUCATION

START YOUR OWN TECHNICAL VENTURE! Don Lancaster's newly updated **INCREDIBLE SECRET MONEY MACHINE II** tells how. We now have autographed copies of the Guru's underground classic for \$18.50. Synergetics Press, Box 809-K, Thatcher, AZ 85552. 520-428-4073. VISA/MC.

DON LANCASTER'S ACTIVE FILTER COOKBOOK is back in print. Autographed copies of the seventeenth(!) classic printing \$28.50. **SYNERGETICS PRESS**, Box 809-N, Thatcher, AZ 85552. 520-428-4073. Visa/MC.

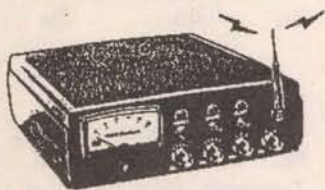
GRAND UNIFIED THEORY MADE EASY. 110 page book explains a new theory linking gravity, electronics & magnetism. Explores universe mysteries, goes beyond relativity & quantum theory. \$9.95. To order: send check or M/O to American Science Innovations, PO Box 155, Clarington, OH 43915.

WANTED: SOMEONE to teach me PIC and/or single board computers. I have some knowledge, but need more! I have a project that needs stepper motor controls, among other things. Would like to find someone in the central NJ area if possible. E-MAIL: GARYBAL@AOL.COM

BUSINESS OPPORTUNITIES

MILITARY COMPONENTS wanted. Capacitors, resistors, diodes, transistors, semiconductors, ICs. Electronic Material Industries, 818-769-1002, FAX: 818-769-1084.

MILLIONS \$\$\$ in "scrap gold" from old computers and electronics junk. Message: 603-645-4776 or www.tiac.net/users/quiksand/goldtek.htm



COUNTER SURVEILLANCE=\$250 HR! Electronic eavesdropping is unbelievably widespread! Are you sure you're safe? Learn how others (without prior experience) earn \$250 HR in the fascinating field of COUNTER-SURVEILLANCE! For FREE catalog call: 1-800-732-5000.

PIC'n Books

LEARN ABOUT PIC16/17 MICROCONTROLLERS

EASY PIC'n Beginner

- Programming techniques
- Instruction set
- Addressing modes
- Bit manipulation
- Subroutines
- Sequencing
- Lookup tables
- Interrupts
- Using a text editor - source code
- Using an assembler
- Timing and counting
- Interfacing - I/O conversion
- Lots of examples

\$29.95

PIC'n Up The Pace Intermediate

- Serial communication
- PIC16 to peripheral chips
- PIC16 to PIC16
- Serial EEPROMS
- LCD interface
- Scanning keypads
- D/A conversion
- Sensors - analog voltage output
- A/D conversion
- Math routines
- Decimal interface
- PIC16F84 EEPROM data memory
- Lots of circuits and code

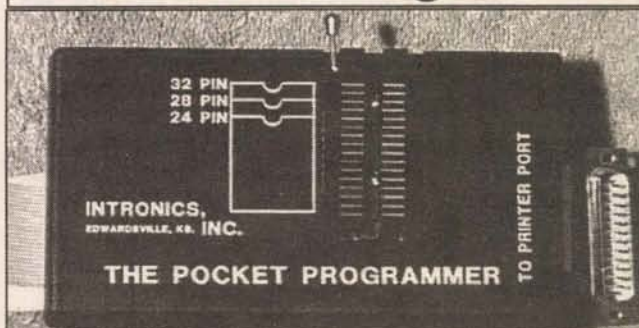
\$34.95

+ \$4 s/h in US for one book, \$5 both books
VISA, MC, AMEX, MO, Check
CA residents please add 7.25% CA sales tax
PIC is a trademark of Microchip Technology Inc.

SQUARE 1 ELECTRONICS

P.O. Box 501, Kelseyville, CA 95451
Voice (707) 279-8881 FAX (707) 279-8883
<http://www.sq-1.com>
E-Mail sqone@pacific.net

The Pocket Programmer



The portable programmer that uses the printer port of your PC instead of an internal card. Easy to use software that programs E(E)prom, Flash & Dallas Ram. 27(C)/28(C)/28F/ 29F/29CXXX & 25XX series from 16K to 8 Megabit with a 32 pin socket. Adapters available for Pic, MCU's 874X, 875X, 40-Pin X 16 & Serial Eprom's, PLCC, 5-Gang, 82/74 Prom's and Eprom Emulator to 32K X 8.

Only \$129.95

Same Name, Address & Phone Number for 16 Years....
Now isn't that Amazing ?

Intronics, Inc.

Box 13723 / 612 Newton St.

Edwardsville, KS 66113

Tel. (913) 422-2094

Fax (913) 441-1623 Visa / Master Charge / Amex

Add \$5.00 COD

Add \$4.00 Shipping

START YOUR OWN TECHNICAL VENTURE! Don Lancaster's newly updated **INCREDIBLE SECRET MONEY MACHINE II** tells how. We now have autographed copies of the Guru's underground classic for \$18.50. Synergetics Press, Box 809-K, Thatcher, AZ 85552. 520-428-4073. VISA/MC.

THE CASE AGAINST PATENTS. Thoroughly tested and proven alternatives that work in the real world, \$28.50. **SYNERGETICS PRESS**, Box 809-N, Thatcher, AZ 85552. 520-428-4073. Visa/MC.

WHAT! YOU don't have **TELECODE'S** NEW 1998 "HACKER CATALOG," yet! 125+ items. Call 520-726-2833. Surf online at <http://www.hackerscatalog.com>

REPAIRS - SERVICES

PINBALL MACHINES! Books, Magazines, Manuals, Diagrams, Supplies, Parts. \$2 catalog, Marco Specialties, 5290-N Platt Springs Rd., Lexington, SC 29073-9252. 803-957-5500. FAX 803-957-6974. E-Mail: tilt@ix.netcom.com <http://pinballmachine.com>

PICS, GALS READ if you've lost your masters. Programming service available. Call for info. Network Sales, 616-683-0500.

FOR THE BEST PRICES ON PROFESSIONAL TOOLS, CALL ELECTRO-TOOL



platt - Case - Deluxe Polypropylene. Chemical Resistant. Tools by CooperTools and others. 800T Case, complete with tools ... \$419.95
800T Case Only ... \$121.80



platt - Case - Cordura Exterior. Two exterior pockets & one literature pocket. 660ZT Case, complete with tools ... \$223.00

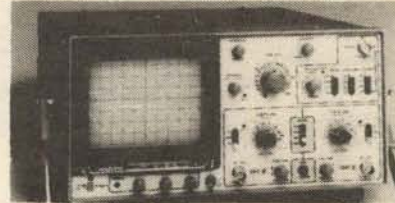
660ZT Case Only ... \$59.45

Optional Sperry meter #DM6510 as shown ... \$65.00



Weller WCC100 - Electronically controlled station, temperature adjustable from 350°F-850°F, Zero voltage circuit-safe for sensitive components, 40 Watt pencil ... \$97.90

OptiVISOR - Superior magnification, Optical Glass Prismatic lenses (not plastic). Select any one of (6) magnifications ... \$24.00



GoldStar - 20 MHz Dual Trace Oscilloscope OS-9020A-Large 6" rectangular, high sensitivity: 1mV/div., high accuracy: ±3%, stable, low-drift design, 8 divisions of displayed dynamic range and accurate, distortion-free waveform measurements ... \$372.00

Electro Tool, Inc.



9103 Gillman, Livonia, MI 48150
Customer Service: (734) 422-1221
ORDERS ONLY: 1 (800) 772-3455
FAX: (734) 422-3432



"Tools American Made."

SERVICE REPAIR TIPS for FREE! PROFESSIONAL BOARD LEVEL & COMPONENT LEVEL REPAIRS for TVs, VCRs, projection TVs, CAMCORDERS, CD players, audio and other repairs on computer disk. **ADD** your repairs. **PRINT** out repairs. **BACKUP** & save your repairs. Want to share your repair tips? If you do, we'll send you **FREE** updates! Ask about our **TIP EXCHANGE** policy. For IBM compatible computers with a hard drive. Get your **FREE Stage 1 SERVICE TIPS Now! FREE CALL. CALL NOW 1-800-215-5081.**

PC BOARDS REPAIRED. Prices start at \$5. Minimum 5 of one type. Network Sales, 616-683-0500.



ALL CABLE NEEDS SE HABLAN ESPAÑOL CONVERTERS ALL BRANDS WITH REMOTE

TOLL FREE ORDER LINE:

1-800-361-4586

ALSO

HOOK-UP HELP LINE:

1-630-889-0281

NO ILLINOIS SALES



ACQUA-LINE

**COMPETITIVE
PRICING**

**PARENTAL
LOCKOUT
AVAILABLE**

HOURS: Mon. thru Fri.
9-6, Sat. 10-2

**30-DAY MONEY BACK
GUARANTEE
1 YEAR WARRANTY**

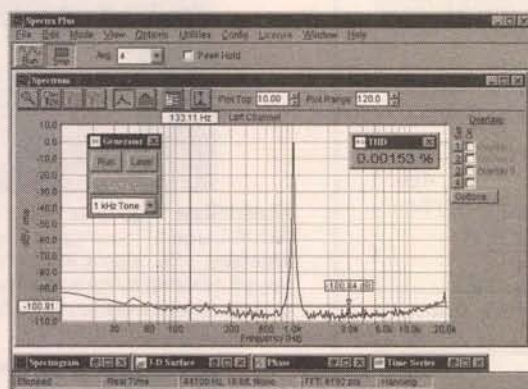
KDE ELECTRONICS CORP.
P.O. BOX 1494, ADDISON, IL 60101

Write in 94 on Reader Service Card.

Turn Your Multimedia PC into a Powerful Real-Time Audio Spectrum Analyzer

Features

- 20 kHz real-time bandwidth
- Fast 32 bit executable
- Dual channel analysis
- High Resolution FFT
- Octave Analysis
- THD, THD+N, SNR measurements
- Signal Generation
- Triggering, Decimation
- Transfer Functions, Coherence
- Time Series, Spectrum Phase, and 3-D Surface plots
- Real-Time Recording and Post-Processing modes



Applications

- Distortion Analysis
- Frequency Response Testing
- Vibration Measurements
- Acoustic Research

System Requirements

- 486 CPU or greater
- 8 MB RAM minimum
- Win. 95, NT, or Win. 3.1 + Win.32s
- Mouse and Math coprocessor
- 16 bit sound card

Priced from \$299

(U.S. sales only - not for export/resale)

**DOWNLOAD FREE 30 DAY
TRIAL!**

www.spectraplus.com

PHS Pioneer Hill Software
24460 Mason Rd.
Poulsbo, WA 98370
a subsidiary of Sound Technology, Inc.



Spectra Plus
FFT Spectral Analysis System

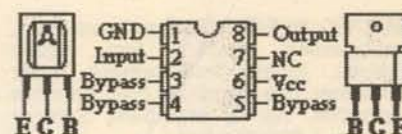
Sales: (360) 697-3472

Fax: (360) 697-7717

e-mail: pioneer@telebyte.com

(E)EPROM PROGRAMMING done quickly and economically. One day turn around typical. Simple copy \$3 per device. Also prototyping, design, and consulting services available. Call or send SASE to: **Luzer Electronics, 4023 North Bayberry, Wichita, KS 67226. 316-687-2127, FAX 316-687-3103.**

ENGINEERING CONSULTING. Product development from conceptual to manufacturing stages. Digital, analog, and RF expertise. Microcontroller designs for HC05xx, HC11xx, and PIC families. Software design for IBM PC. XILINX and Altera FPGA design. In-house schematic capture and PWB. Hicks Electronic Design, PO Box 7366, Loveland, CO 80537-0366. Toll Free 1-888-849-6792 E-Mail: steve@hickseng.com website: www.hickseng.com **PROFESSIONAL PRINT-ED** circuit design on CAD, over 30 years experience. All types of designs: conventional, multilayer, downhole, fine line. Prototype and production boards fabricated. Reverse engineer existing two layer boards. Quick service with affordable cost. Call now for your quote. Tel 713-952-8623, Fax 713-952-8624.



SEMICONDUCTOR CROSS-REFERENCE Library (SCRL) software with 378,000+ devices, drawings, and descriptions for the PC, \$69 plus \$6 S&H. Add on modules: **ELECTRONIC REPAIR TIPS:** 78,000+ original tips, \$30. **FCC ID CODE** listings \$10. **SAMS PHOTOFACTS** complete listing \$10. **SEMICONDUCTOR MANUFACTURERS LISTINGS:** 107,000+ devices \$20. Subscribe to monthly updates and Save. Checks & credit cards accepted. E-Mail: sales@electronic-repair.com Web: <http://www.electronic-repair.com> Custom Software Creators, PO Box 30415, Clarksville, TN 37040. 931-647-6120, Fax 931-551-4128.

WELD ALUMINUM WITH PROPANE! EZ, INEXPENSIVE, STRONG. DETAILS: WEEKS, 36 CAROLINA ST., TAYLORS, SC 29687. 1-800-547-WELD(9353) FAX 864-244-6349. <http://www.dura-fix.com>

TECH FORUM

Continued from page 44

your QB version, I was able to run it on GW-BASIC 3.20, 3.22, and 3.23 (as well as on QBASIC) with exactly the same results. (If you run it on GWBASIC 1.00 or 2.02, you will need to remove the words FOR RANDOM from the OPEN COM statement (or you will get a syntax error.)

My testing showed that the RS/Micronta-suggested GWBASIC program is structurally sound and yields consistent, identical results whether run on GWBASIC or QBASIC. Therefore, it appears that one or more parameters may be incorrect. I am suggesting five changes you can try. One change at a time:

Change

1. COM1 to COM2.
2. 1200 to 300 (also try 2400, 4800, 9600, 1800, 600, 150, 110, and 75 in place of 1200).
3. N,7,2 to N,8,2 (also try N,8,1 in place of N,7,2).
4. A\$ = "D" to A\$ = "d" (also try other letters A through Z, both upper and lower case, in place of D).
5. INPUT\$ (14, #2) to INPUT\$ (3, #2).

Change #5 presupposes that less than 14 (but at least three) characters were transmitted by your multimeter. If you do get three characters displayed (including any spaces), then you can try the other values 4 through 13.

If there are multiple incorrect parameters, it will be difficult to find them due to the large number of possible combinations. My testing did not address the possibility of inadvertent omission of line(s) of code in the RS/Micronta-suggested GWBASIC program.

For example, the lines A\$ = "D": PRINT #2, A\$ seem to be a command to the meter saying 'read data.' But what if you have to initialize your meter by sending it an "I" before you can 'read data?' Or, what if you have

to send it a "T" to tell it to 'Transmit' to your computer after you have 'read data?'

If none of my five suggested changes to your QB version work, then perhaps it's time to contact RadioShack/Micronta technical support.

Roger Omori
North Hollywood, CA

ANSWER TO #109810 - OCT. 1998

I do not have a schematic for parallel port to IDE, but I can point you to something very close.

Check out the GIDE (Generic IDE interface to a Z80) series of articles available in back issues (#63, 64) of *The Computer Journal*. This is by far the best technical reference to how the IDE interface works.

Check their web site or link to it from the online article "Connecting IDE Devices to 8-bit Machines" from www.blkbox.com/~jdb8042/SmallS ys/8bitIDE.html.

Barry Cole
Sunnyvale, CA

ANSWER TO #11981 - NOV. 1998

The HP Paintjet Printer went out of production in 1993. According to HP, they will stop producing the ink cartridges in July 1999, but to answer your questions on the serial port and switches.

The serial port pinouts are:

Pin#	Top Side		
	6o	7o	8o
1	3o	4o	5o
2	1o	2o	
IBM PC	MAC		
1	DTR	Handshake Out	
2	NC	Handshake In	
3	Transmit	Data Negative	
4	GND	Signal Ground	
5	Receive	Data Negative	
6	Transmit	Data Positive	
7	NC	General Purpose In	
8	Receive	Data Positive	

TECH FORUM

To make the printer work with an IBM compatible, you need to twist pins 3 & 6 with 5 & 8 as these pairs compliment each other in data transmission, you also need to carry through the ground and DTR so the computer can tell if the printer is on and off.

The best way to test the printer is with DOS mode command which allows you to remap the LPT port to the desired serial port.

On = 0
Off = 1

The Switches

1 OFF	ON
7 ROM8	PC8
6 MET	ENG
5 SCS	NORM
4	A4
3	A3
2	A2
1	A1
2 OFF	ON
ROM8	PC8
MET	ENG
DTR	XON-XOFF
S4	Parity
S3	Parity
S2	Baud
S1	Baud

Baud Rate	S1	S2
9600	0	0
4800	1	0
19200	0	1
1200	1	1

Parity	S3	S4
None	0	0
Odd	1	0
Even	0	1
One	1	1

perhaps to extend battery life.

There are three methods of coupling the transmitter to the cable: direct connection with clip leads, inductive coupling with a snap-around current transformer, and inductive coupling with an antenna.

The direct connection probably consists of a step-down transformer to provide a low output impedance output at 447.5 KHz and a small series capacitor for a high output impedance at 60 Hz (so an energized line does not burn out the transmitter).

The receiver assembly appears to be a tuned ferrite rod antenna at one end of a long stick and the receiver electronics at the other. The receiver electronics probably has a tuned RF amplifier, an AM detector, a narrow 1000 Hz band-pass filter, and a speaker/signal strength meter. A receiver sensitivity adjustment allows a sensitive coarse search followed by a less sensitive fine search.

These wire locators work by detecting the magnetic field produced by the wires. The transmitter forces current to flow in the underground wires.

The transmitter frequency is high enough that even open wires will conduct current due to cable capacitance (1000 pF has a reactance of about 300 ohms at 447.5 KHz). The current flow produces a weak magnetic field, and the sensitive receiver detects that field.

Gerald Roylance
Mountain View, CA

This Information is obtainable at http://hpcc923.external.hp.com/cposupport/printers/support_doc/bpd01032.html

You might also wish to try one of the following HP support phone numbers: 877-283-4684, 208-344-4131, and 208-323-2551.

You may contact me at 717-728-0833 for further assistance, or at WKM@PANETWORK.COM

Wesley K. Miller
Camp Hill, PA

ANSWER TO #11983 - NOV. 1998

Ideal Industries has two instruments for locating underground wires: the 62-120 Wire Hunter Kit and the 62-135 Underground Cable Location Kit. Both instruments will work on energized circuits.

The latter is more sensitive, and claims to detect cables up to seven feet deep or as long as 4,000 feet.

The 62-135 has a transmitter and a receiver. The transmitter outputs 447.5 KHz with a 1000 Hz modulation (presumably AM). The transmitter power is adjustable to avoid overloading the receiver and

ATTENTION DEALERS

BUY DIRECT FROM THE WHOLESALE

GET THE BEST PRICES AND SERVICE

ALL UNITS ARE IN STOCK FOR IMMEDIATE SHIPMENT

CABLE CONVERTERS AND ACCESSORIES

CALL FOR PRICING ON ITEMS NOT LISTED

	QTY 5	QTY 10	QTY 25	QTY 50	QTY 100
NEW CONVERTERS					
CENTURY CT-3000	\$64	\$60	\$55	\$50	CALL
COMMERCIAL-11	\$75	\$70	\$65	\$62	CALL
VIEWSTAR-550 MHZ	\$50	\$45	\$42	\$38	CALL
DIGITECH-550 MHZ	\$55	\$49	\$48	\$46	CALL

EXPLORER CONVERTERS

EXP-6600	\$250	\$225	\$200	\$175	CALL
----------	-------	-------	-------	-------	------

PANASONIC CONVERTERS

PAN-175/VOL	\$165	\$155	\$145	\$135	CALL
-------------	-------	-------	-------	-------	------

WE WILL MEET OR BEAT ANY ADVERTISED PRICE

1-800-800-0766

KIMTRONIX

30 day money back guarantee. All shipping and handling at customers expense. Anyone implying theft of cable service will be denied sale. NO FLORIDA SALES. WE WILL MEET OR BEAT ALL COMPETITOR'S PRICES IN THIS MAGAZINE

Write in 96 on Reader Service Card.

ALFA ELECTRONICS

HIGH QUALITY TEST EQUIPMENT

Visit www.alfaelectronics.com for complete info

Call 1-800-526-2532 for Order and Free Catalog

DMM	TOP/COUNTER	FLUKE	SPECIALTY
DMM-89S (\$179.00): true rms, AC/DC (V,A), Ω , bar graph, freq, capac, dBm, logic, diode	CAP-15 (\$49.95): 3 1/2 digit, 0.1pF-20mF, 9 Ranges, 0.1pF resolution, zero adjustment	12B \$94.95	AC Current Probe \$34.95
DMM-23T (\$99.95): 4 1/2 digit, true rms, high resol. (10 μ V, 10nA, 10m Ω), hFE, diode, contin.	LCR-24 (\$119.95): 0.1 μ H-200H, 0.1pF-2000 μ F, 0.01 Ω -20M Ω , diode test. New Model	70-III \$99.00	DC/AC Current Probe \$79.95
DMM-20 (\$74.95): AC/DC (V,A), Freq, cont., Capac, Induct, Ω , hFE, diode, duty cycle	LCR-131D (\$219.95): autorange, 0.1 μ H-10kH, 0.1pF-10mF, 1m Ω -10M Ω , Q Factor, serial/parallel, 120Hz/1kHz testing mode	73-III \$125.00	Mini AC Clamp \$59.95
DMM-122 (\$59.95): DC/AC(V,A), Ω , hFE, diode, capacitance, freq, logic, continuity	FC-1200 (\$129.95): 1.25GHz Handheld, 8 digits display, 10ppm accuracy, sensitivity 5mV (130-350MHz), 30mV (440MHz)	75-III \$155.00	AC Clamp w/temp \$89.95
DMM-123 (\$44.95): DMM + capacitance, DC/AC(V,A), Ω , hFE, diode, continuity		77-III \$173.00	DC/AC Clamp \$109.95
DMM-10 (\$19.95): 3 1/2 digit, DC/AC V, Ω , hFE, diode, signal output(+3V, -0.5Vsq, 50% duty)		79-III \$195.00	Thermometer \$69.95-\$89.95
		87-III \$325.00	IR Thermometer \$189.95
		92B-III \$1,445	Sound Level Meter \$169.95
		96B-II \$1,695	Tachometer \$169.95-\$219.95
		99B-III \$2,095	EMF Tester \$69.95
		105B \$2,495	Pressure Meter \$299.95
		123-III \$1,130	Watt Meter \$129.95
		863E \$555	High Voltage Probe \$59.95
		867B \$740	pH Meter \$79.95
			Light Meter \$79.95-\$89.95

Single Output DC Power Supplies

• Constant current, constant voltage mode	• Independence or Tracking operation
• Short Circuit and overload protected	• Parallel to double current output (PS-8102 & PS-8103 only)
Analog Meters Display	Triple Output (Analog display)
PS-303 (\$159.00) 30V/3A	PS-8102 (\$399.95) 30V/3A/30V/3A
PS-305 (\$219.95) 30V/5A	PS-8103 (\$489.95) 30V/5A/30V/5A
PS-8112 (\$399.95) 60V/5A	Digital Displays
PS-1610 (\$289.00) 16V/10A	PS-8202 (\$499.95) 30V/3A/30V/3A
PS-8107 (\$399.95) 30V/10A	PS-8203 (\$549.95) 30V/5A/30V/5A

Triple Output

• Independence or Tracking operation	• Independence or Tracking operation
• Parallel to double current output (PS-8102 & PS-8103 only)	• Parallel to double current output (PS-8102 & PS-8103 only)

AUDIO/RF/FUNCT. GEN.

RF Generator • SG-4160 (\$124.95) 100kHz-150MHz sine waves in 8 ranges	• SG-4162AD (\$229.95) with 6 digit counter
Audio Generator • AG-2601 (\$124.95) 10Hz-1MHz, 0-8Vpp sine, 0-10Vpp square wave	• AG-2603AD (\$229.95) with 6 digit counter
Function Generator • FG-2100A (\$154.95) 0.2Hz-2MHz, 5mV-20Vpp	• FG-2103 (\$329.95) Sweep 0.5Hz-5MHz

20 MHz Scope	Cursor Readout	Triple Output	Single Output	Programmable	FUNCTION GENERATOR	BENCHTOP DMM
• OS-620 \$324.95	• OS-626G \$599.95	• 2 variable out 0-30V, 0-3A	• Const voltage, current mode	• Auto serial/parall. (PPT ser)	FG-8020G (\$209.95)	DM-8034 (\$179.95) 3 1/2 dgt
• Most economical scope	• Readout a Cursor meas	• One fixed 5V, 3A output	• Voltage regulation $\leq 0.01\%$	• Auto track (PPT series), IEEE-488.2 and SCPI compatible command set	• 0.02Hz-2MHz w/counter	• AC/DC(V,A), C, Ω , diode
• Dual CH/X-Y operation	• Dual CH / Delay sweep	• Auto track, serial, parallel	• Current regulation $\leq 0.2\%$	• PPS-3635G (\$1,149.95) 18V/6A	• Sine/Squ/Tri/pulse/Ramp	• DM-8040 (\$339.95) 3 1/2 dgt
• 1 mV/div sensitivity	• Built-in delay line	• Const. volt, current mode	• PS-1830 (\$198.95) 18V/3A	• PPS-3635G (\$1,149.95) 18V/6A	• 0.02Hz-2MHz w/counter	• ACV to 50kHz, true rms
• Z-axis input, CH1 output	• ALT trigger, Hold-Off	• 4 analog or 2 digital display	• PS-1830D (\$214.95) 18V/3A	• PPS-3635G (\$1,149.95) 18V/6A	• FG-8050 (\$449.95) Sweep	• DM-8055G (\$889.95) 5 1/2 dgt
• TV syn, ALT trigger	• Z-axis input, CH1 output	• PC-3030 (\$499.95)	• PS-1850D (\$244.95) 18V/5A	• PPT-3615G (\$1,499.95) 36V/1.5A	• 0.05Hz-5MHz w/counter	• 0.006% accuracy, GPIB
• 2 probes (x1, x10)	• 2 probes (x1, x10)	• PC-3030D (\$549.95) digital			• INT/EXT AM/FM mod	• dBm, auto, REL, min/max

ALFA ELECTRONICS
P.O. BOX 8089
PRINCETON, NJ 08543-8089

TEL: (800)526-2532 / (609) 897-1135
FAX: 609-897-0206
E-mail: sales@alfaelectronics.com

Call / Write / Fax / Email for FREE CATALOG
Visa, MC, AMEX, COD, PO Accepted. OEM Welcome.
1 Year Warranty (2 Years for GW/Instek)

Write in 97 on Reader Service Card.

Nuts & Volts Magazine/December 1998 65

TECH FORUM

ANSWER TO #10986 - OCT. 1998

You did not indicate the type of rotor you have, so the assumption is made that it is one of the common alliance (U-110 types) or Telex (AR-40 type) rotors.

If so, you will not be able to tell direction without the control box associated with these rotors. Both control boxes use a stepper driven directional indicator plate (with arrowed knob) to tell direction.

They usually indicate direction in five-degree increments: S-W-N-E-S clockwise rotation. They will not rotate continuously under limit switch control, beyond 360 degrees, preventing the antenna wire from wrapping around the mast.

In general, the five wires are used for the following:

Ground (1); 24V AC capacitor driven motor lead (1); Stepper mag-

net contact through ground (1); Motor counter clockwise limit through ground (1); Motor clockwise limit through ground (1).

Using an ohmmeter, you can identify the AC motor winding. This lead will be the only high-resistance reading, the remaining switches when closed will be 0 ohms. The AC capacitor is always located in the control box, the stepper contracts operate off of a cam in the rotor

head, reversal of the direction stepper is controlled by contacts on the direction shaft arm.

Sams manuals 1191-SED, 1208-SED, 254-T10 may be able to help you and can be obtained by calling 1-800-428-7267.

John Lippert
Menomonee Falls, WI

ANSWER TO #11988 - NOV. 1998

The problem is not with your monitor, but with your video card. There are three components in the display system: the monitor, video card, and the software driver.

A VGA monitor uses analog RGB information, so it can display an essentially unlimited number of colors, so your problem is with the video card or its driver.

Windows setup allows you to select the software driver. A driver disk usually comes with the video card. Windows also includes drivers for several manufacturers (you can get drivers from manufacturer web-sites).

Examine the video card to find the manufacturer and the model number. Windows has a generic VGA driver that should work for all VGA cards — but it may not handle the resolutions or bit depths that your video card offers.

Using the wrong driver can prevent the monitor from syncing. Selecting a mode (a combination of resolution and color depth) the video card does not support will also prevent sync.

Your VGA card may not support 256 colors — or it may not support 256 colors at the resolution you have selected. The amount of memory on the video card determines the number of colors.

By looking at the card, you may be able to determine the amount of memory. An 800x600 display (0.5 megapixel) with 256 colors (8 bits = 1 byte) requires 0.5 MB of memory. If the video card has only 0.25 MB of memory, then it could only display 16 colors (4 bits = 0.5 byte).

If your video card has some empty sockets on it, then you could add more memory chips to get more colors.

An easier solution is buying a new video card — they should be less than \$20.00 now.

The monitor does not limit the color depth, but it will limit the display resolution because its sync circuits have a limited frequency range.

Your monitor should support 640x480, but it may also support 800x600 and possibly even 1024x768 (SVGA). Your card may produce the correct signals, but your monitor may not support the selected resolution.

Gerald Roylance
Mountain View, CA

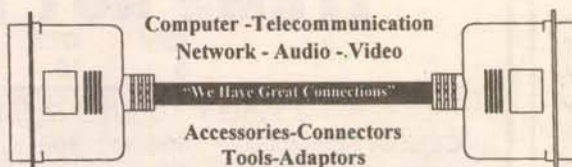
Continued on page 81

Roger's Systems Specialist

We accept Purchase Orders:

- Government
- Schools
- Firms*

(*w/approved credit)



We now offer discounts to members of PC User Groups!

HARRIS
110 punchdown tool blades for network punch blocks.
NEW ITEM
#Special\$2.50 each
or 5/\$10.00

Microphone

Stick-on monitor or clip on shirt, 6 ft. cord, condenser mic.

#TM-MIC-2.....\$1.00 ea

7' Category 5 crossover network cable
computer to computer
TE-068-L5X
Retail Price..... \$9.00
Roger's Price..... \$1.00

20' Audio Cable

Stereo extension cables, for speakers and headphones
3.5mm, gold plated male to female, shielded, 20 ft.

#AC-560.....\$4.50 each

Andrea
ELECTRONICS CORPORATION
Headphone with high quality microphone, used for net meetings, and voice dictation.

Stereo Headphone w/mic (TM-165)

Retail Price..... \$30.00 ea
Roger's Price..... \$6.00 ea
QTY. 100+..... \$4.50 ea

Mono Headphone w/mic (TM-165-MONO)

Retail Price..... \$30.00 ea
Roger's Price..... \$3.50 ea
QTY. 100+..... \$2.00 ea



10'	6'
ROGER'S PRICE	ROGER'S PRICE
QTY 1-19 \$5.00 EA.	QTY 1-19 \$3.00 EA.
QTY 20-49 \$4.60 EA.	QTY 20-49 \$2.70 EA.
QTY 50-99 \$4.25 EA.	QTY 50-99 \$2.35 EA.
QTY 100+ \$3.99 EA.	QTY 100+ \$2.20 EA.
PART # CC-PR1-SPBL	PART # CC-PR6-SPBL

Lifetime Warranty

Roger's Systems Specialist
24895 Avenue Rockefeller
Valencia, Ca 91355

1-800-366-0579

www.rogerssystems.com

Local
805-295-5577
FAX
805-295-8777

\$10.00 minimum order required • Add \$4.50 shipping for pre-paid orders • Prices subject to change without notice.

All major credit cards accepted. • Special offers only valid on items in stock • California residents add 8.25% tax

eMail sales@rogerssystems.com

Call for quantity discounts • No out of state checks accepted • Most orders shipped same day! • Not responsible for errors in typesetting.

Trademarks are the property of their respective companies.

All photographs are for illustration purposes only and may not be a true representation of actual products.

DEALER DIRECTORY

The dealers listed below carry the latest issue of Nuts & Volts, for your convenience.

ALABAMA

Little Professor Book Center
2717 S. 18th St.
Birmingham 35209
RT Systems
Amateur Radio Supply
8207 Stephanie Dr.
Huntsville 35802

ARIZONA

Batteries, Batteries
3415 W. Glendale Ave. #4
Phoenix 85051

1829 E. Southern Ave.
Tempe 85282

6245 E. Bell Rd.
Scottsdale 85254
Elliott Electronic Supply
1251 S. Tyndall Ave.
Tucson 85713

The Electronic Thrift Store
12329 N.W. Grand Ave. #F
El Mirage 85375
Tower Records
3 E. 9th St.
Tempe 85281

AUSTRALIA

DonTronics
P.O. Box 595
29 Ellesmere Cres.
Tullamarine 3043
www.dontronics.com

CALIFORNIA

Abletronics
9155 Archibald Ave. Unit E
Cucamonga 91730

Advanced Computer Products, Inc.
1310 "B" E. Edinger Ave.
Santa Ana 92705

All Electronics
905 S. Vermont Ave.
Los Angeles 90006

14928 Oxnard St.
Van Nuys 91411

Allen's To Go
13461 Hwy. 88
Lockeford 95237

Alltronics
2300-D Zanker Rd.
San Jose 95131

Brand Newsstand
234-1/2 N. Brand Blvd.
Glendale 91203

Centerfold International
716 N. Fairfax Ave.
Los Angeles 90046

Del Amo Books & News
3758 Sepulveda Blvd.
Torrance 90505

Electro Mavin
2985 E. Harcourt St.
Rancho Dominguez 90221

Ford Electronics
8431 Commonwealth Ave.
Buena Park 90621

Harding Way News
113 W. Harding Way
Stockton 95204

Harold's Newsstand
524 Geary St.
San Francisco 94102

HdB Electronics
2860 Spring St.
Redwood City 94063

Hi-Fi Doctor
1814 E. Ball Rd.
Anaheim 92805

HSC Electronic Supply
4837 Amber Ln.
Sacramento 95841

3500 Ryder St.
Santa Clara 95051

5681 Redwood Dr.
Rohnert Park 94928

JK Electronics

6395 Westminster Ave.
Westminster 92683

Laurel Park News
4346 Laurel Canyon Blvd.
Studio City 91604

Lion Electronic Labs
4948 E. Townsend Ave.
Fresno 93727

Netseller
7207 Arlington Ave. Ste. G
Riverside 92503

Op Amp Technical Books
1033 N. Sycamore Ave.
Los Angeles 90038

Panorama Electronics
8737 Van Nuys Blvd.
Panorama City 91402

Sandy's Electronics Supply, Inc.
20655 Soledad Cyn. Rd. #15
Santa Clarita 91351

Sav-On Electronics
13225 Harbor Blvd.
Garden Grove 92643

The Red Barn
Hwy. 299
Bieber 96009

Tower Books
211 Main St.
Chico 95928

7840 Macy Plaza Dr.
Citrus Heights 95610

1280 E. Willow Pass Rd.
Concord 94520

630 San Antonio Rd.
Mountain View 94040

1600 Broadway
Sacramento 95818

5950 Florin Rd.
Sacramento 95823

2538 Watt Ave.
Sacramento 95812

2727 El Camino Real
San Mateo 94403

Tower Magazines/News
885 Riverside Pkwy.
West Sacramento 95605

Tower Records/Video
220 N. Beach Blvd.
Anaheim 92801

2520 Durant
Berkeley 94704

212 F St.
Davis 95616

5703 Christie Ave.
Emeryville 94608

2052 Redwood Hwy.
Greenbrae 94904

6310 E. Pacific Coast Hwy.
Long Beach 90803

2280 Market St.
San Francisco 94114

3205 20th Ave.
San Francisco 94132

2525 Jones St.
San Francisco 94133

871 Blossom Hill Rd.
San Jose 95123

1205 W. Covina Pkwy.
West Covina 91790

Video Electronics
3829 University Ave.
San Diego 92105

CANADA

Com-West Radio Systems Ltd.
48 E. 69th Ave.
Vancouver, BC V5X 4K6

Muir Communications Ltd.
3214 Douglas St.
Victoria, BC V8Z 3K6

COLORADO

TH Electronics
216 Commerce Dr., Unit 2
Ft. Collins 80524

Tower Records/Video
2500 E. 1st Ave.
Denver 80206

Western Test Systems
530 Compton #C
Broomfield 80020

CONNECTICUT

Archway News
64 Bank St.
New Milford 06776

Electronic Service Products
437 Washington Ave.
North Haven 06473

DELAWARE

Newark Newsstand
70 E. Main St.
Newark 19711

DISTRICT OF COLUMBIA

Tower Records
2000 Pennsylvania Ave.
Washington 20006

FLORIDA

Alfa Electronic Supply
1502 S. St. Rd. #7
Hollywood 33023

Al's News
8219 S.W. 124th St.
Miami 33156

Bob's News & Books
1515 S. Andrew Ave.
Fort Lauderdale 33316

Clarks Out of Town News
303 S. Andrews Ave.
Fort Lauderdale 33301

Mike's Electronic Distributing Co.
1001 N.W. 52nd St.
Fort Lauderdale 33309

Skycraft Parts & Surplus, Inc.
2245 W. Fairbanks
Winter Park 32789

Sunny's At Sunset, Inc.
8260 Sunset Strip
Sunrise 33322

GEORGIA

Tower Records
3400 Around Lenox Dr.
Atlanta 30326

HAWAII

SolarWorks!
525 Lotus Blossom Ln.
Ocean View 96737

Tower Records
4211 Wai'alae Ave.
Honolulu 96816

611 Keeaumoku
Honolulu 96814

IDAHO

The Current Source
5159 Glenwood
Boise 83714

ILLINOIS

City Newsstand
4018 N. Cicero
Chicago 60641

Tower Records/Video/Books
383 W. Army Trail Rd.
Bloomington 61708

2301 N. Clark St. #200
Chicago 60614

1209 E. Golf Rd.
Schaumburg 60173

INDIANA

Harbourtown Sales
108 Park 32 W. Dr.
Noblesville 46060

KANSAS

Hollywood At Home
9063 Metcalf Ave.
Overland Park 66212

Lloyd's Radio & Electronic, Inc.
220 W. Harry St.
Wichita 67213

LOUISIANA

Lakeside News
3323 Severn Ave.
Metairie 70002

MARYLAND

Silicon Valley Electronics
2014-A Industrial Dr.
Annapolis 21401

Tower Records/Video
2566 Solomons Island Rd.
Annapolis 21401

1601 Rockville Pike #210
Rockville 20852

MASSACHUSETTS

Full Spectrum Communications
244 Essex St.
Salem 01970

Newsbreak, Inc.
579 G.A.R. Hwy. Rt. 6
Swansea 02777

Tower Records #172
360 Newbury St.
Boston 02115

MICHIGAN

Little Professors Book Center
22174 Michigan Ave.
Dearborn 48124

MW Electronics
229 E. Michigan Ave.
Paw Paw 49079

Purchase Radio Supply, Inc.
327 E. Hoover Ave.
Ann Arbor 48104

Tower Records
1214 S. University Ave.
Ann Arbor 48104

MINNESOTA

Radio City, Inc.
2633 County Road 1
Mounds View 55112

MISSOURI

Accurate Instruments
11201 E. 24 Hwy.
Independence 64054

Electronics Exchange
8644 St. Charles Rock Rd.
St. Louis 63114

NEVADA

Amateur Electronic Supply
1072 N. Rancho Dr.
Las Vegas 89106

Less Busler's Electronics
2930 N. Las Vegas Blvd.
VSTG-22

North Las Vegas 89030

Radio World
1656 Nevada Hwy.
Boulder City 89005

Tower Records/Video
4580 W. Sahara Ave.
Las Vegas 89102

6450 S. Virginia
Reno 89511

NEW JERSEY

Sys-Com
707 22nd St.
Union City 07087

JR Tech Systems
1309 Hwy. 71
Belmar 07719

NEW MEXICO

Newsland Bookstore
2112 Central S.E.
Albuquerque 87106

NEW YORK

All Phase Video Security, Inc.
70 Cain Dr.
Brentwood 11717

Goldcrest Electronics
480 St. Paul St.
Rochester 14605

Ham Central
3 Neptune Rd.
Poughkeepsie 12601

Hirsch Sales Corporation
219 California Dr.
Williamsport 14221

Tower Records/Video
105 Old Country Rd.
Carle Place 11514

350-370 Route 110
Huntington 11746

1961 Broadway
New York 10023

383 Lafayette St.
New York 10003

OHIO

Compustuff
241 Great Oaks Trl.
Wadsworth 44281

Digital One
7603 Mentor Ave.
Mentor 44060

Footsteps
4925 Jackman Rd. Store #58
Toledo 43613

Hosfelt Electronics, Inc.
2700 Sunset Blvd.
Steubenville 43952

Keyways, Inc.
611 S. Main St.
Miamisburg 45342

Leo's Book Shop
330 N. Superior St.
Toledo 43604

Powermaxx, Inc.
1587 U.S. Route 68 N.
Xenia 45385

OKLAHOMA

Steve's Books & Magazines
2612 S. Harvard
Tulsa 74114

OREGON

News & Smokes
2295 W. Main St.
Medford 97501

News & Smokes #8
259-C Barnett Rd.
Medford 97501

Norvac Electronics
7940 S.W. Nimbus Ave. Bldg. 8
Beaverton 97005

960 Conger
Eugene 97402

1545 N. Commercial N.E.
Salem 97303

Powell's Technical Bookstore
33 N.W. Park
Portland 97209

Taylor News & Books
133 W. Main, Ste. 102
Oklahoma City 73102

Tower Books
1307 N.E. 102nd Ave.
Portland 97220

PENNSYLVANIA

Bedford St. News
308 Bedford St.
Johnstown 15901

Genes Books, Inc.
King of Prussia Plaza
King of Prussia 19406

Lehman Scientific
2997-F Cape Horn Rd.
Red Lion 17356

Montco Electronics &

Computers

2555 Industry Ln. Ste. D
Norristown 19403

Penn Electronics
2310 A Walnut St.
Harrisburg 17103

Surplus AI
RR 1 Box 337
Hunlock Creek 18621

Tower Books
425 South St.
Philadelphia 19147

Tower Records
340 W. Dekalb Pike
King of Prussia 19406

SOUTH CAROLINA

555 Electronics
5646 Farrow Rd.
Columbia 29203

TENNESSEE

Tower Books
204 W. End Ave.
Nashville 37203

TEXAS

BDL News, Inc.
809 Pierce
Houston 77002

Electronic Parts Outlet
3753-B Fondren Rd.
Houston 77063

Mouser Electronics
958 N. Main St.
Mansfield 76063

Tanner Electronics
1301 W. Beltline #105
Carrollton 75006

Tower Records
2403 Guadalupe
Austin 78705

VIRGINIA

Satellite Headquarters
7920 Timberlake Rd.
Lynchburg 24502

Tower Records/Video/Books
4110 W. Ox Rd. #12124
Fairfax 22033

1601 Willow Lawn Dr.
Richmond 23230

8389 E. Leesburg Pike
Vienna 22182

WASHINGTON

A-B-C Communications, Inc.
17541 15th Ave. N.E.
Seattle 98155

Bohica Concepts
214 2nd St.
Morton 98356

Cody Books Ltd.
1125 Fir Ave.
Blaine 98230

Service Request
3304 W. Rowan Ave.
Spokane 99205

Supertronix
18650 68th Ave. S.
Kent 98032

Tower Books
10635 N.E. 8th St.
Bellevue 98004

20 Mercer St.
Seattle 98109

WISCONSIN

Amateur Electronic Supply, Inc.
5710 W. Good Hope Rd.
Milwaukee 53223

Greenfield News & Hobby
6815 W. Layton Ave.
Greenfield 53220

Cudahy News & Hobby Ctr.
4758 Packard Ave.
Cudahy 53110

A/D CONVERTERS with SERIAL OUTPUT

Tiny (1.75"x1.41") fully assembled and tested printed circuit board includes two 8-bit A/D converters and one digital input. Up to 16 units addressable (DIP switch setting) totalling 32 converters on a single serial port. Output is ASCII encoded bit count (0 to 255) at 2400 BPS via RJ-11 interface. Fully programmed PIC16C71 installed in IC socket. Sample software in BASIC included. Requires 8-28Vdc At 1-2mA. *\$49.95. Optional DC adapter \$19.95. Add \$5.00 shipping.



Tele: 847-891-2584
Fax: 847-891-2587
www.glentech-rf.com

SURPLUS SALE

1,000,000 WALL TRANSFORMERS



3VDC/100MA CX099 \$0.75
6VDC/100MA CS039 \$1.45
9VDC/100MA CR314 \$1.45
12VDC/200MA CS033 \$0.99
13.5VAC/400MA... CR574 \$1.29
24VDC/500MA... CR174 \$3.40

Min 1000/type -- Call for other types

SURPLUS TRADERS

PO Box 276,
Albany, VT 05440
Tel: (01) 514-739-9328
Fax: (01) 514-345-8303
http://www.73.com/w

FREE CATALOG!

PROGRAMMERS OVER 50 MODELS

ADVANTECH EETOOLS NEEDHAM DATA I/O ICE TECHNOLOGY HILO
SYSTEM GENERAL CHROMA MODULAR CIRCUIT TECHNOLOGY XELTEK



PROMAX EMP-20 MEGAMAX MEGAMAX4 SIMM/SP TESTER EMUPA

CALL ADVANTECH LABTOOL 599 EETOOLS SIMMAX
629 ICE TECH MICROV 795 CHROMA SIMM/SP
650 EETOOLS ALLMAX + 359 MOD-MCT-EMUPA/R
409 EETOOLS MEGAMAX 279 MOD-MCT-EMUPA/R
509 EETOOLS MEGAMAX4 49 EPROM 1G TO 512K
369 XELTEK SUPERPRO II 69 EPROM 1G TO 1MEG
409 XELTEK SUPERPRO II P 99 EPROM 4G TO 1MEG
249 XELTEK SUPERPRO L 199 EPROM 16G TO 1MEG
165 XELTEK ROMMASTER II 89 EPROM 1G TO 8MEG
479 MOD-MCT-EMUPA 129 EPROM 4G TO 8MEG
739 STAG ORBIT-32 250 EPROM 8G TO 8MEG



LABTOOL48 MICROMASTER SUPERPRO ALLMAX PLUS ROMMASTER2

General Device Instruments

Sales 916-393-1655 Fax 916-392-4949
Web www.generaldevice.com E-Mail icodevice@best.com

BATTERY — YUASA



Sealed Lead-Acid/Gel-Cell
12V: 7AH \$19, 2.3/4AH \$16
18AH \$39, 1.2AH \$13
6V: 4AH \$9, 10AH \$13

Quantity Discounts Available
Call for other models

Aventrade

4518 Temple City Blvd.
Temple City, CA 91780
Tel: 626-286-0118 Fax 626-287-9618
E-Mail: aventrade@aol.com

Serial Problems???

Use your PC compatible desktop or laptop computer to debug serial communications problems with **Serial**, our test tool for serial communications.

Serial works with the standard data rates and asynchronous serial formats commonly found in modern office and industrial environments. Suitable for development, service work, and end-user problem diagnosis.

- Easy to Use
- Menu and Windows
- Highly Configurable
- Contextual Help
- Autobaud Detect
- Time Stamping
- Custom font editor for EGA/VGA Screens
- Saves Configurations
- Extensive Manual
- Block transmit ability
- CRC/LRC generation

Serial, with manual \$99.95

Cable for full duplex monitoring \$49.95

For Orders and Inquiries Call: 1-800-980-9806

Allison Technology Corporation

2006 Finney Valley Rd., Rosenberg, TX 77471

281-239-8500 • 281-239-8006 FAX

GET IT UP BEFORE WINTER!

MARCONI ANTENNA 700W 50 Ω
THE BEST "LITTLE" LOW BAND ANTENNA

**EASY TO
INSTALL.**

— 160M —
130' OVERALL
\$53.95 PP

— 80M —
67' OVERALL
\$46.95 PP

THE OCR, AN OPTICALLY COUPLED
REGEN. IS AN EXCEPTIONAL REGEN
RECEIVER KIT. EASY TO ASSEMBLE.
(SEE QST JUNE 98) \$91.95 PP

SEND FOR FREE CATALOG:

• SMART BATTERY CONTROLLER KITS

• CODE PRACTICE OSCILLATOR \$23.45 PP

• CURTIS KEYSER KIT \$46.95 PP

1-800 JADE PRO (523-3776)

www.jadeprod.com/

email: jadepro@jadeprod.com

JADE PRODUCTS INC. E. HAMPSTEAD NH 03826-0368

PCB's in Minutes From LaserPrint!*

8 1/2" x 11" Sheets
* Or Photocopier
Use household
iron to apply.



PnP BLUE or PnP WET

For High Precision Professional PCB Layouts

1. LaserPrint

2. Iron-On

3. Peel-Off

4. Etch

Adds an Extra Layer of Resist for Super Fine Lines on Std Clad Bds

20Sh\$30/40Sh\$50/100Sh\$100 Blue/Wet (No Mix)

Sample Pack 5 Shets Blue + 5 Shets Wet \$20

VISA/MC/PO/CK/MO \$4 S&H -- 2nd Day Mail

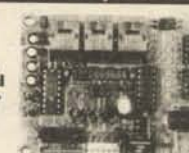
Techniks Inc. P.O. Box 463 Ringoes NJ 08551

(908)788-8249

100% Money Back Guarantee-Dealer Inquiries Invited

Convert RS-232 to RS-485 or TTL/CMOS for Only \$49.00

Communicate up to
4,000 feet, at up to
1 MEGA-BPS, full
or half duplex, up to
32 units on one serial
link, with 31 jumper
options for flexible
configuration, LED
indicators.



COMMUNICATIONS CONVERTER

- FULL SCHEMATIC AND DOCUMENTATION
- FULL FAMILY OF MODULAR DESIGNS
- RS-485/RS-422 REMOTE I/O MODULE KITS
- NETWORK SOFTWARE AND SOURCE CODE
- AUTOMATIC OR RTS UNITS AVAILABLE
- RJ-11/12 CONNECTORS OR TERMINAL STRIP
- TURN YOUR PC INTO A DISTRIBUTED DATA ACQUISITION AND CONTROL SYSTEM

R.E. SMITH

(513) 874-4796

4311 TYLERSVILLE RD. ■ HAMILTON, OHIO 45011

www.rs485.com

TV 85 PJ & TV 86 CABLE CONVERTERS VOLUME & NON-VOLUME CONTROL

SALES/SERVICE
VOICE 1-800-473-0506
FAX 1-800-488-0525

FOSS WAREHOUSE DISTRIBUTORS

285 Schenck St.
N. Tonawanda, NY 14120

www.fossww.com

PCBs
PER SQIN
\$100.00 SETUP
WE SPECIALIZE IN SINGLE SIDED, 1 OZ, PC75

9¢

**PCB
LAYOUT**
PER COMPONENT PIN \$100.00 MINIMUM

59¢

**ENGINEERING
DIAGRAMS**
PER COMPONENT PIN \$100.00 MINIMUM

39¢

V&V MACH. & EQUIP., INC. (HOUSTON, TX OFFICE)

PH (281) 397-8101 FAX (281) 397-6220

MARKETING TECH. S.A. (MEXICO/PLANT)

PH 011 (525) 361-3351 FAX 011 (525) 361-5996

Peltier Junction:

While They Last!
1 3/16" x 1 3/16"
cooling area
Quantity Pricing
Available



WITH HEATSINK AND LEADS
**\$10 EACH
OR THREE FOR \$25**

SHREVE SYSTEMS
318-424-9777

Ask for Jake

HTTP://WWW.SHREVEYSTEMS.COM

RGB Color Composite Displays ON SALE!



*refurbished with 90-day warranty

ONLY \$79!!

Excellent for studio, lab or
surveillance applications
640x480 resolution, RCA-style connectors

Returns subject to a 15% restocking fee. Prices are
subject to change without notice.

WE ACCEPT VISA, MASTERCARD, AMEX, DISCOVER

Telecom Hardware/Software Developers

STOP using your phone lines to test and demonstrate your telecom devices. Our affordable telephone line simulators offer authentic USA dial tone, busy signals, ringing, and exceptional speech quality.



RING-IT! TELCO SIMULATOR
• Single Line (two RJ-11 Jacks)
• LED Display
• DTMF Operation
• Automatic Ring-up Mode
• \$325 (\$149 kit available)

PARTY-LINE TELCO SIMULATOR

- Six Extensions
- Caller-ID (Name/Nbr)
- Distinctive Ringing



Digital Products COMPANY

134 Windstar Circle

Folsom, CA 95630 USA

Tel: 916-985-7219

Fax: 916-985-8460

http://www.digitalproductsco.com

ADAPT-11 & ADAPT-12 Low-cost modules for HC11 & HC12 plug into solderless breadboards

- Evaluate your idea instantly!
- Breadboard it, for quick hardware changes
- Program it in-circuit, for quick software changes
- Debug your application— not the basics!

ADAPT-11 Modules feature three 8-bit I/O ports, SPI, SCI, eight 8-bit
analog input channels, hardware timers/counters, & interrupts. All
Starter Packages include PC serial download cable, documentation, &
disk of utilities & examples. Bundle ImageCrash C for Windows (ICC11)
with any Starter Package for an additional US\$120 + \$5 S&H.

HC11 Starter Package Configurations:
AD11-SP 2K EE/256 bytes RAM US\$ 74.95 + \$5 S&H
AD11C75-SP 8K EE/512 bytes RAM US\$ 87.00 + \$5 S&H
AD11C750K-SP 8K EE/32K bytes RAM US\$120.00 + \$5 S&H
AD11-SP64K ADAPT-11 w/ 32K EE/32K RAM memory expansion
card & dual slot adapter (2 I/O ports lost) US\$123.00 + \$5 S&H

ADAPT-12 features 68HC12A4, 1K EE, 1K RAM, 85 I/O lines,
eight high speed 8-bit analog inputs, memory expansion connector,
RS232 & RS485, convenient firmware bootloaders, plus support for all
BDM pds. All this on a compact 2.25" x 3.25" board. Starter
Package (AD12-SP) US\$99 + \$5 S&H. Add US\$125 for ICC12WIN.
AVAILABLE SOON! ADAPT-12 features 68HC12B32 (32K
Flash, 768 EE, 1K RAM, 56 I/O lines, 8 chan. analog), RS232 and
RS485. All this and more on a compact 2.25" x 3.25" board! Starter
Package (AD12-SP) US\$99 + \$5 S&H. Add US\$125 for ICC12WIN.

TECHNOLOGICAL ARTS
voice/fax: (416) 963-8996
www.interlog.com/~techart

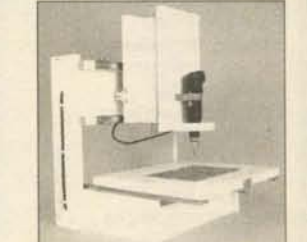
HIGH PERFORMANCE ULTRA-MINIATURE PINHOLE LENS CAMERA W/ CASE

The "NEW" MiniCam 1 (in a
durable, metal case) is the
smallest pinhole camera in the
industry! Its actually smaller
than the board cameras
currently on the market. Comes w/
mounting bracket & power supply for easy
installation. • High resolution—more than
420 lines, 0.1 lux • Ultra miniature -
lightweight & measures only 29mm x 29mm
x 12mm. • Pinhole lens offers sharp image
w/highened sensitivity • Can be easily
mounted behind a 1/8" hole for any
custom/covert applications. ONLY...\$79.00

Surveillance Catalog \$5.00

SPY OUTLET
2468 Niagara Falls Blvd • Tonawanda NY 14150
(716) 695-8660 Fax 695-7380 www.spyoutlet.com

3-Axis Machine

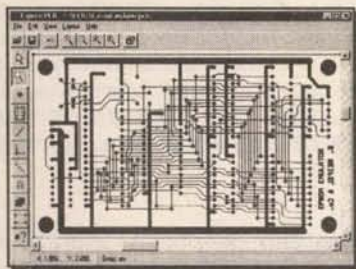


Full function 3-axis machine kit based
on Parallax's BASIC Stamp 2.

- 3 Stepper motor drive with 4 thou resolution
- Approx 12"x12"x18" when assembled
- Kits from \$299
- Includes PCB Drilling software and Stamp code

Millard Instruments - England
Tel: 011-44-1977-683665 Fax: 1977-681 465
www.millinst.demon.co.uk

PC Board Layout Software



www.expresspcb.com

ATTENTION DEALERS

WHOLESALE ONLY!

• ANY CABLE MFG
CONVERTERS & ACC

• BEST PRICING &
SERVICE

• SHOP US NOW

PANASONIC • NOVA, ETC.

800-777-7731

ATOMIC TIME FOR ANY COMPUTER

WWVB based time code receiver and
real time clock with RS232 interface

FEATURES

Sensitive receiver
Direct UTC readout in ASCII
Y2K compatible calendar
0.1 second accuracy
RS232 powered
Low cost

APPLICATIONS

Remote data acquisition
Embedded systems
Automatic sequencers
Tamperproof time stamping

ULTRALINK

702 782 9758 www.ulio.com

EPS

EPROMS AS LOW AS **25¢**

27C256	27C040	27C1024	87C51
27C512	27C400	28F010	8751
2732A	27C4096	28F020	8755
27C32	574000	28F040	68705
27C128	574200	8749H	2564
27C64	27C402	8748H	2516
2716	27C020	8741	
2708	27C210	8742	
27C512-90	27C010	8744	

PROCESSOR

62256 & 6264 & 6116	8255
GAL16V8 & GAL22V10	8254
PIC16C54 & PIC16C56	80C31

SPECIAL 2764

TEL: (818) 774-9444 • FAX: (818) 774-0822

WE BUY EXCESS INVENTORY

FREE SAMPLE COPY! ANTIQUE RADIO CLASSIFIED

Antique Radio's Leading
Monthly Magazine

Articles - Classifieds - Ads for Parts &
Services. Also: Ham Equip. - Books -
Telegraph - 40's, 50's & 60's Radios -
Early TV - Auction Reports & more...

1-Year: \$39.49 (\$57.95 by 1st Class)

6-Month Trial - \$19.95. Foreign - Write.

A.R.C., P.O. Box 802-G23
Carlisle, MA 01741
Call: 978-371-0512 • Fax: 978-371-7129
Web: www.antiqueradio.com

EQUIPMENT FOR SALE

ELECTRONIC TEST

Tektronix	EXT 330
Hewlett-Packard	EXT 331
Other Manufacturers	EXT 332
MEASURE & INSPECT	EXT 333
VIDEO PRODUCTS	EXT 370
SCIENTIFIC & LAB	EXT 335
LASERS	EXT 340
POWER SUPPLIES	EXT 334
COBWEB CORNER	EXT 380

COMPLETE INDEXEXT 300

To obtain information via FAX: A) Have your fax
number ready. B) Dial 1-800-547-4636. C)
Request above Extension Numbers.

DEXIS CORPORATION

(612) 944-7670 FAX (612) 942-9712
9749 HAMILTON ROAD
EDEN PRARIE, MN 55344

CUT MANUFACTURING COST!

CUSTOM METAL BOXES WE ACCEPT SMALL ORDERS TOO

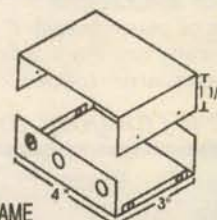
SHEET METAL

20 GAUGE

SILK SCREEN

PRINTED

WITH YOUR CO. NAME



ALSO PCB, SMT, PROTOTYPES, ASSEMBLY,
PLASTIC MOLDS, INJECTION MOLDING.

USA Office: V&V Mach. & Equipment, Inc.
Ph: (281) 397-8101, Fax: (281) 397-6220.
Mexico Plant: Marketing Tech.
Ph: 011 (525) 361-3351, Fax: 011 (525) 361-5996.

CUSTOM PLASTIC PARTS

• MODELS (WOOD AND
RESIN). TO EVALUATE
YOUR PARTS BEFORE
COMMITTING TO
MANUFACTURE A MOLD.
• MOLD DESIGN AND
BUILDING.



• PRODUCTION OF
INJECTION MOLDED
PARTS. NO ORDER
TO SMALL OR TO
BIG.
• VERY COMPETITIVE
ON HIGH LABOR
PARTS.

We also have manual low pressure machines for
injection molding of very small runs or prototypes of
parts up to 2 oz. At a surprisingly low price.

USA Office: V&V Mach. And Equip. Inc.
Tel: (281) 397-8101, Fax: (281) 397-6220.
Please send blue prints or samples to:
Marketing Tech. S.A. • Alamo 93, 4 Piso • Sta. Monica,
Tlal • Eco. De Mexico 54040 • Tel. 011 (525) 361-3351.
Fax: 011 (525) 361-5996. ATTN: VICTOR M. MENDOZA
e-mail: marktech@infotel.net.mx

ASSEMBLY & ENGINEERING

Producible designs since 1970
Contract Engineering

Embedded Microprocessors
PCB Layout and Packaging Design
Analog Including RF to 1 GHz
Instrumentation
A/D and D/A

Contract Assembly

High-Speed Fuji Surface Mount
Through hole
Turn-key or Kit
Run sizes one through thousands
Test and burn-in available

Bilocon Corp.
800-736-5927
425-353-2276
www.bilocon.com

ST241A

Stereo microscope

\$240.00

New - 1 year
warranty



cabud Technical
3580 Haven Avenue
Redwood City, CA 94063-4603

650/367-8320
Fax - 365-5845

Email: jllittle @ netwizards.net

CONTROL • MEASURE • INPUT

MODEL 40-\$109

• RS-232 interface
• 28 lines digital I/O
• Eight analog inputs
• PWM output
• Three stepper ports



MODEL 100-\$279

• 12-bit 100KHz A/D • Four analog outputs
• Three timer counters • 24 digital I/O



PRAIRIE DIGITAL, INC.

920 SEVENTEENTH ST., INDUSTRIAL PARK
PRAIRIE DU SAC, WI 53578
TEL: (608) 643-8599 • FAX: (608) 643-6754

CALLER ID PHONE w/ELECTRONIC ORGANIZER! w/1500 NUMBER SPEED DIALER AND MUCH MORE!!



\$49.95
+ S&H
MC/VISA

TURNER TECHNOLOGIES
www.turnertechusa.com
616-475-8531

10 Hr. Telephone Recorder \$69



Automatically starts recording when the
phone is picked up and stops when you hang
up. Records both sides of the conversation!
BEST PRICE AROUND!

FREE CATALOG
www.mscelectronics.com

MSC Electronics

PO BOX 461 Jessup, MD 20794
(301) 497-1600
FAX (301) 497-1925

1 MB cache, AMD 300

3DNow System featuring: 11/11/98
Enlight Mini Tower, VIA chipset, 100 MHz
operation, 2 USB ports, 64 MB PC-100
compatible memory, 6.4 GB IBM UDMA-
33 drive, 32X CD-Rom with audio button, 4
MB SGRAM AGP video card, S3-Trio3D
chipset, 1.44 floppy, V.90/X2 PCI faxmo-
dem, 3D sound card, full-size speaker set,
15" digital monitor, Windows 98...\$963

tech-specialties, Inc.

(800)864-5391, fax: (713)307-0314
email: sales@ts.nu, web: www.ts.nu

Detailed Quote on other configurations (PII
300/450, single/dual CPU or low cost, 233
MHz/32 \$570 w. monitor) by email, fax or
phone. Ask for Free Shipping and Catalog!

Monarch Bar Code Equipment

8900B Power Calibrator	\$40
3400A Voltmeter	\$75
3465A Digital Voltmeter	\$275
Tek 176 Pulse Current Fixture	\$35
436A Power Meter	\$500
1715A Oscilloscope	\$150
8654 Signal Generator	\$200
905A Coaxial Slide Load	
1.8-18GHz HP	\$200
911A Coaxial Slide Load	
2.0-18GHz HP	\$200
11638A Type N Cal. KitTek	
P6045 FET probe package	\$150
Tek P6046	\$200
Tek P6201	\$150
HP 33321K Attenuator/70dB	\$150
8411A	\$70
8732B	\$50

ADDITIONAL PLUG-INS

7A11...\$25; 7A14...\$50; 7B92...\$75; 7A13...\$50;
7A18...\$35; 7B92A...\$75; 7B85...\$50; 7A25...\$50

T.T.I. • 616-475-8531 • 616-475-8534 fax
FREE CATALOG • CALL TODAY
www.turnerequipment.com

GPS Units

Trimble Placer 400
6 Channel w/3" diam. Antenna
\$59.95

Trimble Placer 300
6 Channel w/Wedge Antenna
\$99.95

Survey Software / Antennas
Call for a List or Fax to 713-522-6309

Communications Surplus

713-526-8000 or 877-878-6GPS
lshafer@flash.net

HOW TO PLACE A CLASSIFIED AD

TYPE or PRINT your **ELECTRONICALLY RELATED** ad copy **CLEARLY** (not all caps) on a separate piece of paper. Spell out words when submitting handwritten copy. Calculate the number of words and multiply it by the appropriate rate (see RATE PER WORD section). Include any charges for bold and/or CAPPED words, any artwork costs that would be applicable, and/or costs for boxing your ad (explained below). Choose the appropriate classification for your ad(s) to appear in (see below). If no classification is indicated, it will be placed in Misc. Electronics or wherever we deem most suitable. **Enclose your name, address, phone number, and Nuts & Volts account number from your mailing label** (if available) for identification purposes. Include full payment — **CLASSIFIEDS RUN ON A PRE-PAID BASIS ONLY** — and mail your completed order to:

NUTS & VOLTS MAGAZINE, 430 Princeland Ct., Corona, CA 91719.

RATE PER WORD

The ad rate for **current PAID subscribers** is **60¢** per word. All others pay **\$1.20** per word. There is a **\$9.00 minimum** charge per ad per insertion.

WORDS IN BOLD AND/OR ALL CAPS

Words to be set in **bold** or **CAPS** are each **10¢** extra PER WORD. **BOLD CAPS** are **20¢** extra per word. The first two words of each ad are bold capped at no charge. Indicate bold words by underlining. Words normally written in caps (e.g., IBM) and accepted abbreviations such as VAC or MHz are NOT charged as all cap words. Use a two-letter abbreviation for states.

PHOTOS, DRAWINGS, AND BOXES

A photo or drawing may be run at the top of your classified ad for an additional **\$10.00** (1" depth max.) for camera-ready art. No wording is allowed in this area. Add a one-time charge of **\$5.00** to enlarge, reduce, or duplicate line

art, or **\$8.00** for halftone of photographs. To **BOX** your ad, include an additional **\$50.00** for copy-only ads, or **\$75.00** for ads with art or photos.

FAXING IN AD COPY

You may fax in ad copy or changes before the closing date (5:00pm on the **5th**) at 909-371-3052 using MasterCard or Visa. Include credit card expiration date, the name that appears on the card, a daytime phone number, and your *Nuts & Volts* account number. Ads without credit card information will not be listed as received until payment is received in full. **WE DO NOT CALL OR FAX BACK VERIFICATION OR QUOTES OF FAXED-IN ADS.** For verification of faxed-in ads, please call 909-371-8497.

DEADLINE

Prepaid ads received by 5:00pm on the **closing date (5th of the month)** will appear in the following month's issue. Ads postmarked through the **5th**, but received after the closing date, will be placed in the next available issue. No cancellations or changes after the 5th. Cancellations and changes must be submitted in writing.

IMPORTANT INFORMATION

All classified ads are running copy only. No special positioning, centering, dot leaders, extra space, etc. is allowed. All advertising in *Nuts & Volts* is limited to **electronically related items ONLY**. All ads are subject to approval by the publisher. We reserve the right to reject or edit any ad submitted. We do not take ad copy or changes over the phone. We do not bill for classified ads. Repeat ads or ads run in multiple classifications within the same issue are allowed. Paid subscribers may run ads at the 60¢ rate only through their subscription expiration date. **NO REFUNDS.** Credit only. No credit for typesetting errors will be issued unless you *clearly* print or type your ad copy.

Choose a category for your ad from the classifications listed below.

10. Ham Gear For Sale	80. Test Equipment	120. Components	155. Manuals/Schematics Wanted
20. Ham Gear Wanted	85. Security	125. Microcontrollers	160. Misc. Electronics For Sale
30. CB/Scanners	90. Satellite Equipment	130. Antique Electronics	170. Misc. Electronics Wanted
40. Music & Accessories	95. Military Surplus Electronics	135. Aviation Electronics	175. BBS & Online Services
50. Computer Hardware	100. Audio/Video/Lasers	140. Publications	180. Education
60. Computer Software	110. Cable TV	145. Robotics	190. Business Opportunities
70. Computer Equipment Wanted	115. Telephone/Fax	150. Plans/Kits/Schematics	200. Repairs/Service

ADVERTISER'S INDEX

A & S Wholesale	44	Corporate Systems Center	2, 99	KDE Electronics Corp.	64	Sam's Electronics	90
Abacom Technologies	80	Cruising Equipment	57	Kimtronix	65	Scott Edwards Electronics	77
ABC Electronics	40	Cunard Associates.....	28	La Paz Electronics Int'l.	58	Seabird Technical	69
Ace Computers	52	Danbar Sales Company	46	Lemos International Co., Inc.	74	Shreve Systems	68
ACP Super Store	79	Dexis	19, 69	Linear Systems	13	SIMCO	62
Advanced Educational Systems	35	Digital Products Co.	68	LLH Technology Publishing	83	Skycraft Parts & Surplus, Inc.	79
Alfa Electronics	65	Earth Computer Technologies	50	Lynxmotion, Inc.	18	Spy Outlet	68
All Electronics Corporation	55	E.H. Yost & Co.	50	M2L Electronics	44	Square 1 Electronics	63
Allison Technology Corporation	43, 68	ELECTRO MAVIN	14	Meredith Instruments	85	Surplus Traders	68
Alltech Electronics	84	Electro Tool, Inc.	63	Metric Equipment Sales, Inc.	14	Synergetics	33
Alltronics	76	Electronic Design Specialists, Inc.	74	microEngineering Labs	15	Techniks, Inc.	68
All TV, Inc.	62	Electronic Goldmine	41	Micromint	28	Technological Arts	68
American Innovations, Inc.	36	Electronic Rainbow Ind., Inc.	47	Milford Instruments-England	68	Tech-Plus Industries	54
American Technologies Network Corp.	58	Electronix Express	50	Modern Electronics	58	tech-specialties, Inc.	69
AM Research, Inc.	27	EMAC, Inc.	29	Motron Electronics	20	Telulex, Inc.	62
ANA Instruments	20	EPS	69	Mr. NiCd	50	The RF Connection	78
Andromeda Research.....	18	Equipment Management Technology	35	MSC Electronics	69	Timeless Products	60
Antique Radio Classified	69	ExpressPCB	69	Netcom	31	Timeline, Inc.	21
Ar2 Communications Products	85	Fair Radio Sales	77	Northwest Cable & Connector Co.	90	Tropical Hamboree	59
AST Global Electronics	81	First Call Communications, Inc.	27	One Stop Supplier	88	T.T.I.	69
Aventrade	68	Foss Warehouse Distributors.....	68	Optoelectronics	98	Turner Technologies	69
Basic Electrical Supply		Gateway Electronics, Inc.	53	Pacific Test Equipment Corp.	32	Ultra Link	69
& Warehousing Corporation	80	General Device Instruments	68	Parallax, Inc.	Back Cover	Unicorn Electronics	36
Baylin Publications.....	19	Glentech, Inc.	68	PARAMAX, INC.	75	USI Corp.	30
Bell Electronics	88	Graymark	61	PCW, Inc.	58	Utopia Tools	78
Bilocon Corp.	69	green brook electronics	57	Phelps Instruments	22	V&V Mach. & Equipment, Inc.	68, 69
Bisme Computers Outlet	61	Halted Specialties Co.	3	Pioneer Hill Software	64	Velleman	37
Black Feather Electronics	38	H.T. Orr Computer Supplies.....	60	Polaris Industries	45	VersaTech Electronics.....	82
C & S Sales, Inc.	25, 56	IndustroLogic	82	Prairie Digital, Inc.	69	Viking International	60
C and H Sales Company	51	Information Unlimited	51	P.S. Technology	59	Visitect, Inc.	86
Cableguy's Outlet	86	Inkjet Southwest	48	Pulsar, Inc.	95	Wayside Equip. Corp.	30
Chaffin Electronics	87	Interactive Image Technologies, Ltd.....	7	R & S Surplus	11	Weeder Technologies	40
Chenesko Products, Inc.	29	Intronics, Inc.	63	Ramsey Electronics, Inc.	49	Western Test Systems	16-17
Communications Surplus.....	69	Jade Products, Inc.	68	Resources Un-Ltd.	26	Wholesale Cable	35
Comtrad Industries	5	James' Electronic Services, Ltd.	34	R.E. Smith	68		
Consumertronics	39	J-Works, Inc.	87	Roger's Systems Specialist	66		

AMATEUR RADIO & TV

Abacom Technologies	80
Alltronics	76
Communications Surplus	69
First Call Communications, Inc.	27
Gateway Electronics, Inc.	53
Jade Products, Inc.	68
Lemos International Co., Inc.	74
Ramsey Electronics, Inc.	49
The RF Connection	78

BATTERIES/CHARGERS

Aventrade	68
Cruising Equipment	57
Cunard Associates	28
E.H. Yost & Co.	50
green brook electronics	57
Jade Products, Inc.	68
Mr. NiCd	50

BUSINESS OPPORTUNITIES

Chenesko Products, Inc.	29
-------------------------	----

BUYING ELECTRONIC SURPLUS

ABC Electronics	40
Alltech Electronics	84
Black Feather Electronics	38
C and H Sales Company	51
Dexis	19, 69
Earth Computer Technologies	50
EPS	69
Equipment Management Technology	35
Metric Equipment Sales, Inc.	14
Roger's Systems Specialist	66
Skycraft Parts & Surplus, Inc.	79
Timeline, Inc.	21

CABLE TV

A & S Wholesale	44
All TV, Inc.	62
Basic Electrical Supply & Warehousing Corporation	80
Cableguy's Outlet	86
First Call Communications, Inc.	27
Foss Warehouse Distributors	68
James' Electronic Services, Ltd.	34
KDE Electronics Corp.	64
Kimtronix	65
Modern Electronics	58
One Stop Supplier	88
PCW, Inc.	58
Sam's Electronics	90
Tech-Plus Industries	54
Timeless Products	60
Wholesale Cable	35

CB/SCANNERS

USI Corp.	30
-----------	----

CCD CAMERAS/VIDEO

American Innovations, Inc.	36
American Technologies Network Corp.	58
Black Feather Electronics	38
MSC Electronics	69
Polaris Industries	45
Ramsey Electronics, Inc.	49
Resources Un-Ltd.	26
Seabird Technical	69
Spy Outlet	68
Timeline, Inc.	21
USI Corp.	30

COMPONENTS

Ace Computers	52
Communications Surplus	69
Electronic Goldmine	41
Electronix Express	50
EPS	69
green brook electronics	57
La Paz Electronics Int'l.	58
Linear Systems	13
Pulsar, Inc.	95
Skycraft Parts & Surplus, Inc.	79
Unicorn Electronics	36
Visitec, Inc.	86

COMPUTER

Ace Computers	52
ACP Super Store	79
Allison Technology Corp.	43, 68
Alltech Electronics	84
AM Research, Inc.	27

Bisme Computers Outlet	61
Chaffin Electronics	87
Consumertronics	39
Corporate Systems Center	2, 99
Earth Computer Technologies	50
ELECTRO MAVIN	14
General Device Instruments	68
green brook electronics	57
Halted Specialties Co.	3
La Paz Electronics Int'l.	58
Northwest Cable & Connector Co.	90
Roger's Systems Specialist	66
Shreve Systems	68
Techniks, Inc.	68
tech-specialties, Inc.	69
Ultra Link	69

Software

AM Research, Inc.	27
Bisme Computers Outlet	61
Interactive Image Technologies, Ltd.	7
Pioneer Hill Software	64
Ultra Link	69

Microcontrollers / I/O Boards

Abacom Technologies	80
Advanced Educational Systems	35
AM Research, Inc.	27
Bisme Computer Outlet	61
EMAC, Inc.	29
IndustroLogic	82
La Paz Electronics Int'l.	58
Micromint	28
Motron Electronics	20
Parallax, Inc.	Back Cover
PARAMAX, INC.	75
Prairie Digital, Inc.	69
R.E. Smith	68
Scott Edwards Electronics	77
Square 1 Electronics	63
Technological Arts	68
VersaTech Electronics	82

Printers/Printer Supplies

Chenesko Products, Inc.	29
H.T. Orr Computer Supplies	60
Inkjet Southwest	48

DESIGN/ENGINEERING SERVICES

ExpressPCB	69
Pulsar, Inc.	95
V&V Mach. & Equipment, Inc.	68, 69

EDUCATION

Advanced Educational Systems	35
EMAC, Inc.	29

EVENTS/SHOWS

ACP Super Store	79
Tropical Hamboree	59

KITS

Alltronics	76
C & S Sales, Inc.	25, 56
Digital Products, Inc.	68
Earth Computer Technologies	50
Electronic Goldmine	41
Electronic Rainbow Ind., Inc.	47
EMAC, Inc.	29
Gateway Electronics, Inc.	53
Information Unlimited	51
Inkjet Southwest	48
Jade Products, Inc.	68
Ramsey Electronics, Inc.	49
Scott Edwards Electronics	77
USI Corp.	30
Velleman	37
Wayside Equip. Corp.	30
Weeder Technologies	40

LASERS

Information Unlimited	51
Meredith Instruments	85
Resources Un-Ltd.	26
Unicorn Electronics	36

MISC./SURPLUS

All Electronics Corporation	55
Alltech Electronics	84
Black Feather Electronics	38
C and H Sales Company	51
Chaffin Electronics	87
Communications Surplus	69
Consumertronics	39
Electronic Goldmine	41
Electronic Rainbow Ind., Inc.	47
EPS	69
Equipment Management Technology	35

FIND
what you need ...
FAST
BY PRODUCT
OR
CATEGORY

Fair Radio Sales	77
Gateway Electronics, Inc.	53
Halted Specialties Co.	3
P.S. Technology	59
Resources Un-Ltd.	26
Shreve Systems	68
SIMCO	62
Skycraft Parts & Surplus, Inc.	79
Surplus Traders	68
Timeline, Inc.	21
Unicorn Electronics	36
Viking International	60
Visitec, Inc.	86
Weeder Technologies	40

PROGRAMMERS

Andromeda Research	18
General Device Instruments	68
Intronics, Inc.	63
M2L Electronics	44
microEngineering Labs	15

PUBLICATIONS

Antique Radio Classified	69
Consumertronics	39
LLH Electronics Publishing	83
Netcom	31
Square 1 Electronics	63
Synergetics	33

ROBOTICS

Abacom Technologies	80
Lemos International Co., Inc.	74
Lynxmotion, Inc.	18
PARAMAX, INC.	75
Millford Instruments-England	68

SATELLITE

Baylin Publications	19
---------------------	----

SECURITY

American Innovations, Inc.	36
American Technologies Network Corp.	58
Information Unlimited	51
Lemos International Co., Inc.	74
MSC Electronics	69
Polaris Industries	45
Visitec, Inc.	86

SOLAR EQUIPMENT

Cruising Equipment	57
--------------------	----

STEPPER MOTORS

Alltronics	76
PARAMAX, INC.	75

TELEPHONE

Ar2 Communications Products	85
Bilocon Corp.	69
First Call Communications, Inc.	27
Digital Products, Inc.	68
Telulex, Inc.	62
Turner Technologies, Inc.	69
Weeder Technologies	40

TEST EQUIPMENT

ABC Electronics	40
Alfa Electronics	65
Allison Technology Corp.	43, 68
ANA Instruments	20
AST Global Electronics	81
Bell Electronics	88
C & S Sales, Inc.	25, 56
C and H Sales Company	51
Cruising Equipment	57
Danbar Sales Company	46
Dexis	19, 69
Digital Products, Inc.	68
Electronic Design Specialists	74
Equipment Management Technology	35
Electro Tool, Inc.	63
Glentech	68
Intronics, Inc.	63
J-Works, Inc.	87
Metric Equipment Sales, Inc.	14
Optoelectronics	98
Pacific Test Equipment Corp.	32
Phelps Instruments	22
Pioneer Hill Software	64
R & S Surplus	11
Seabird Technical	69
Telulex, Inc.	62
T.T.I.	69
Western Test Systems	16-17

TOOLS

C & S Sales, Inc.	25, 56
Electro Tool, Inc.	63
Graymark	61
The RF Connection	78
Utopia Tools	78
Wayside Equip. Corp.	30

WIRE/CABLE & CONNECTORS

Northwest Cable & Connector Co.	90
Roger's Systems Specialist	66
The RF Connection	78

I'll bet there isn't a single reader of *Nuts & Volts* who isn't addicted to the nitty-gritty of whipping up a new circuit at the workbench. Soldering, etching, loading circuit boards, wiring, and even troubleshooting are the passions of just about all of us electronics aficionados. And, yet many builders shy away from mastering the one aspect of our craft that the layperson notices first: making the thing look nice.

noticed how common rack-mounted equipment is. There's a good reason for this. Rack panels and rack mounts have been standardized by the Electronic Industries Association (EIA). This guarantees that you can mix and match gear, and it'll always fit properly within your cabinets.

Virtually all pro-equipment comes this way. As it turns out, fabricating nice-looking rack panels is actually fairly painless and less expensive than you might imagine.

I can't begin to count the times I've seen a wonderfully designed circuit tossed together helter-skelter into some tattered box with labels looking like they were done by a kindergartner with a crayon!

Secrets of Making Attractive Rack Panels

by Thomas Henry

I can't begin to count the times I've seen a wonderfully designed circuit tossed together helter-skelter into some tattered box with labels looking like they were done by a kindergartner with a crayon! There's no call for this slipshod approach, if you know the secrets.

This article, then, addresses the problem of making your projects look fabulous, and reveals practical techniques developed over the course of 20 years.

There are many different ways to house your creations. But if you've been involved in electronics for any length of time, then you will have

So, let's dive right in and learn all about it.

RACK PANEL BASICS

As mentioned above, the EIA has specified a standard set of dimensions for rack-mounted gear. These measurements are spelled out in a document entitled, "Racks, Panels, and Associated Equipment," which has been given the reference number of RS-310. (A letter appended to this reference number indicates the current revision of

the specification.) If you'd really like to read this document for yourself, you can probably find it at a local engineering college library. However, it's not exactly the most lively prose in the world! So, we'll extract the pertinent information here and present it in a more user-friendly fashion. In fact, we'll rely heavily on illustrations to make the details even simpler to grasp.

Standard rack panels are 19 inches wide, but the heights can vary. These heights are specified by the term "unit" or more simply by the symbol "U," which is nothing more than an increment of 1-3/4 inches. So, a 1U panel is 1-3/4 inches high, a 2U panel is 3-1/2 inches high, and so on. See Figure 1.

By the way, one of the reasons the RS-310 document is so tedious to read is that the authors have worked in some "slop factors." As an example of the language you'll encounter there, a 1U panel is dictated to have a height of 1.750-0.031 inches. What this is really saying is that a mass-produced item should be just a little less than perfect. The idea is that if you mount a bunch of these guys next to each other, you want to shave them down a bit so that your cabinet doesn't burst at the seams as you plop them in.

Since we're handcrafting our panels (not mass-producing them), we can be a little more exacting and careful. Hence, all of the measurements used in this article are precise, and completely bypass the "slop factor."

As intimated earlier, you'll be securing rack panels into some sort of overall enclosure. The EIA spec indicates that the mounting holes in the rack panel can be either a "closed slot" (an oval hole) or an "open slot." We'll use open slots since making them only requires commonplace tools like a drill, hacksaw, file, and so on.

Rack panels bolt or screw onto the side railings of a rack cabinet. The railings may be nothing more than one inch by one inch pine strips if you're using wood screws to secure the panels, or might be more sophisticated metal strips tapped to accept 10-32 machine bolts. The mounting holes are separated from each other alternately by 1/2 inch and 1-1/4 inch spacings as shown in Figure 2. A moment's reflection should convince you that this arrangement can handle any combination of standard rack panels.

Figures 1 and 2 give us all of the basic theory we need; let's put the theory into practice!

MEASURE TWICE AND ...

The number one secret of making attractive rack panels can be summed up in a single word: planning. In the old days (i.e., more than 10 years ago), this meant hauling out the mechanical pencil, T-square, and draftsman's triangles. You would then come up with some sort of a layout on a large piece of butcher's paper and hope for the best before your

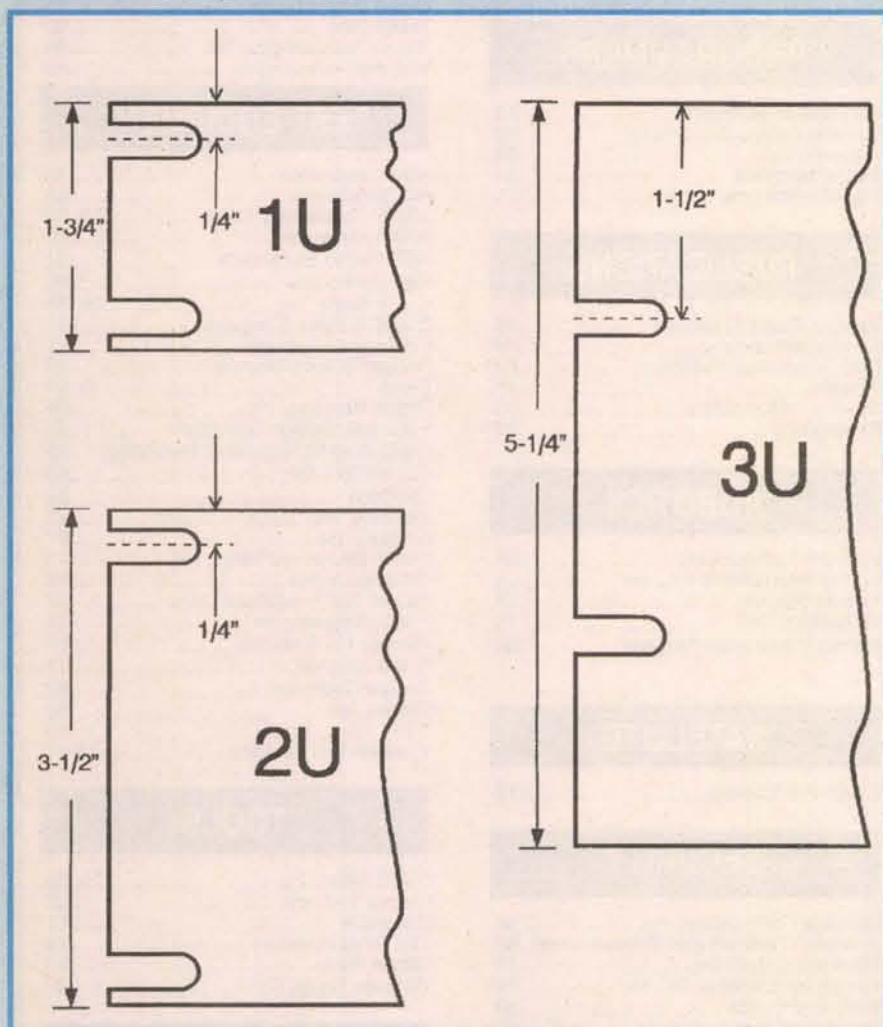


FIGURE 1: Rack panels are always 19" wide, but vary in height by increments of 1-3/4" (called a unit or simply "U"). The three most common are the 1U, 2U, and 3U panels, shown here along with their respective notch spacings. Larger panels follow the same pattern. For example, the next two would be 7" and 8-3/4" in height. The notch spacing from the top and bottom edges is 1/4" for the 1U and 2U panels, and 1-1/2" for the larger panels.

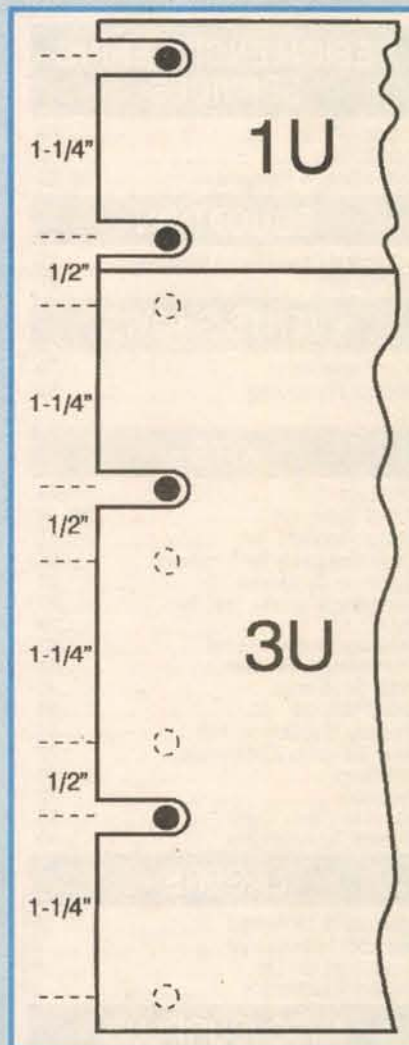


FIGURE 2: This figure depicts a portion of a rack mount with two different sized panels installed. Notice how the mounting holes, alternating at 1/2" and 1-1/4" spacing, accommodate the two panels. In fact, this arrangement can handle any combination of standard rack panels, no matter what their respective heights.



FIGURE 3: With a computer artwork or drafting program, lay out your front panel as in the example shown here. Use reasonable representations of the knobs, switches, jacks, LEDs, and so forth so that you can get a feel for the "ergonomics" of the panel. Allow plenty of finger room between the various controls.

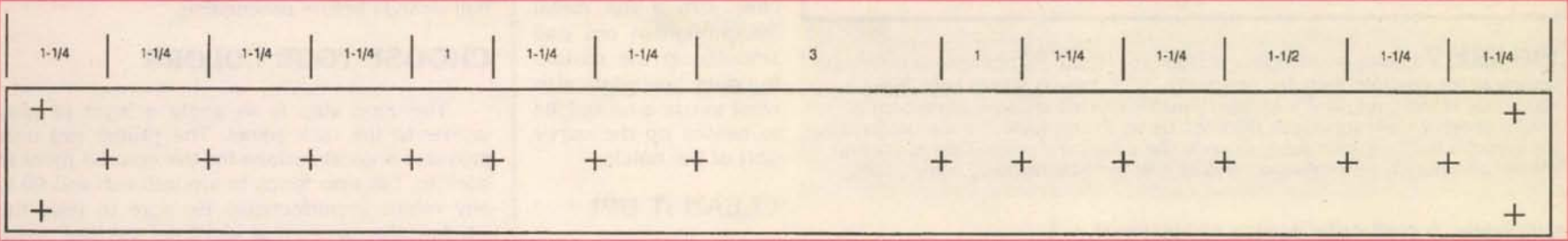


FIGURE 4: Once you are happy with your panel design (see Figure 3), replace the representations of the controls, switches, jacks, etc., with cross-hairs, as shown here. This then becomes your drilling guide. If you print it out full-size, you can attach it directly onto a raw panel with masking tape. Use a metal punch to tap a starter divot at the center of each cross-hair, which will keep the drill bit from "walking."

eraser wore out.

Nowadays, of course, we can use the computer to make things really fly along. So, boot up your favorite artwork or drafting program and start planning now! There's scads of drafting software out there (just do a quick search on the Internet and see), but be sure to pick a program that is accurate, includes alignment grids, and can easily place or center geometrical objects.

My number one choice is GeoDraw, which is part of the Geoworks Ensemble package. It's fast, small, and produces superior scaled or 1:1 hardcopy on just about any printer. If this appeals to you, too, check around the World Wide Web where you'll find many links to the program.

So, with your software running and your mouse all warmed up, start trying out some sample rack panel layouts. You'll probably want to have the actual knobs, switches, and other control paraphernalia nearby so that you can check on the spacings. Figure 3 gives you an idea of what you're shooting for. Use lifesize dimensions if your drafting program permits it. This lets you adjust the "ergonomics" as required.

For example, in my own work, I always allow 1-1/4 inches between potentiometer knobs; this leaves plenty of room for your thumb and finger to twiddle a knob without bumping into the next one. Mini-toggle switches are smaller, as are phone jacks, so only one inch is needed to separate these from their neighbors. By the way, all of your projects will benefit if you choose a standard set of "separation dimensions" and use them consistently.

This is also the time to start putting the panel legends or labels into place. Assuming your drafting software has the capability, experiment with different type styles and fonts. Arrange the labels on the layout as though this were the actual unit. Again, using a lifesize representation makes things simpler, since you can tell beforehand if the knobs or mounting

nuts will foul up or obscure the lettering. Take an extra moment to look over Figure 3 once again, which illustrates these concepts. (This is an actual layout from one of my designs.)

Once you are happy with your layout, print it out full-size and examine it from a variety of

that the layout looks right.

... DRILL ONCE

If you like what you see, then save your design to disk. Now make a copy of it with a new name. Alter this copy by replacing the various controls, switches, etc., with cross-hairs showing the center points of each. This becomes your drilling template. Figure 4 gives the general idea.

Now, print this version out lifesize. With scissors or a razor knife, cut out the entire drawing and secure it to a blank rack panel using masking tape. With an ordinary metal punch, tap divots into the center of each set of cross-hairs. The starting divot is essential when you begin drilling; this will guide the drill bit confidently and keep it from skating all over the place. When you've completed punching the divots, remove the template sheet and discard it.

And this is probably a good time to pause and say something about the blank rack panel mentioned above. If you check the catalogs, you can find a number of mail order houses willing to supply you with painted and/or punched rack panels in either steel or aluminum. First off, avoid the steel ones completely — your drill bits and hacksaw will thank you! Aluminum panels, 1/8-inch thick, are plenty sturdy and yet easy to work with.

Next, the prices demanded for painted or punched panels will alarm you so much that you might suspect they've been cast in gold! Instead, go for a completely blank panel, 19 inches

wide by whatever height you require. You'll cut your own mounting notches and save money, and by painting the panel yourself, you'll not only save again, but get to choose the color scheme you like best. By the way, don't be concerned if the raw panel has surface blemishes or oxidation on it; a later step will clean these up

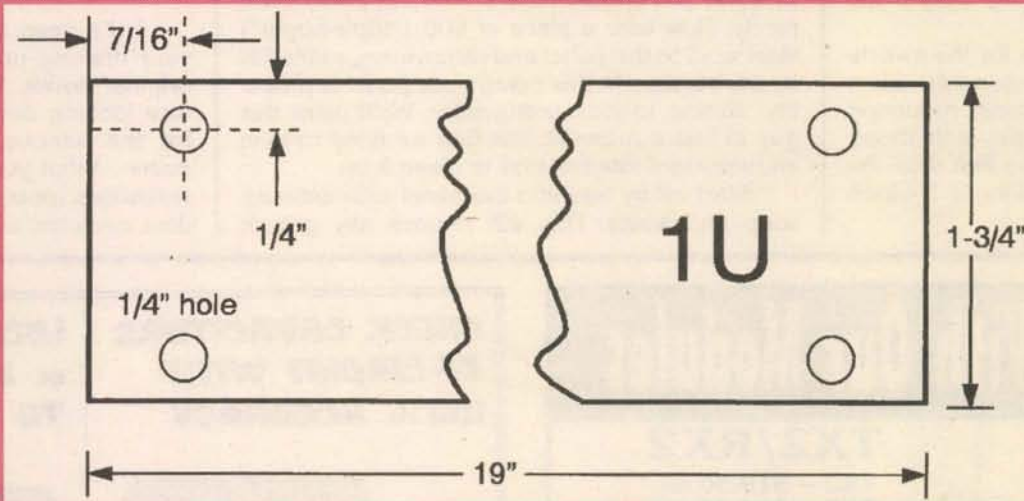


FIGURE 5: The first step in notching a rack panel is to drill 1/4" holes in the four corners. The alignment of the holes is always 1/4" or 1-1/2" from the top or bottom edges (see Figure 1 for details). The 1U panel shown here has its holes 1/4" from the edges.

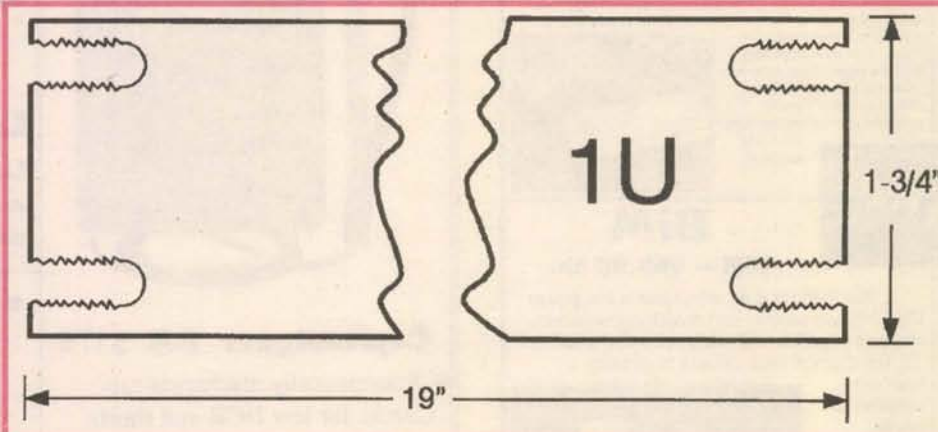


FIGURE 6: Next, the slots are cut out roughly using a hacksaw. Be sure to make them slightly smaller than required. Then with a flat metal file, smooth out the cuts and enlarge the slots appropriately. Keep them neat, straight, and free of burrs.

angles. Since rack panels are 19 inches long, this implies that things will be simpler if you print the hardcopy lengthwise down a continuous sheet of tractor feed paper. But if you're using a laser printer with single sheet feed, you can always tape successive pages together. In any event, spend some time now convincing yourself

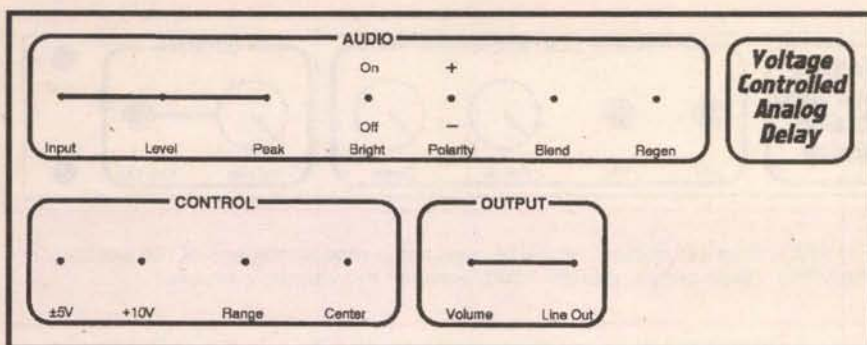


FIGURE 7: Using your original design (see Figure 3), replace the representations of the controls, switches, jacks, etc., with dots, as shown here. Make a hard copy of the page, and then have your local printing house photocopy it onto a sheet of clear stick-back material. Using a razor knife, cut the decals out. Remove the backing, then apply them to the drilled and painted panel. Line-up the decals properly by centering the dots over the various holes in the panel.

completely. A mail order source of inexpensive blank rack panels is listed in the Resources.

But back to the workbench. You're all set to start drilling the holes required by the project. Your first step should be to drill pilot holes in the center of each of the divots you punched earlier. A small bit, like a 3/32 inch, is good for this. And be sure to secure the rack panel firmly in place to a piece of scrap lumber using a C-clamp before beginning to drill. Once the pilot holes are in place, you can then drill the actual control fittings; the pilot hole will keep the larger bit centered and preclude it from walking around the panel.

So, you've now got the holes for the switches, pots, LEDs, and other components taken care of. What about the rack panel mounting slots? Another 15 minutes will dispatch these. Refer to Figure 5 which shows the first step. As illustrated there, you begin by drilling a 1/4-inch hole in each of the four corners.

Well, if everything has gone according to schedule you now have an aluminum panel fully cut and drilled to accept the various controls and switches. And the mounting slots permit it to be slipped into a cabinet for permanent use. The only trouble is that the front surface is a bit scuffed here and there, and other blemishes may detract from the general appearance. That's easy to deal with!

Slip a piece of fine grit sandpaper into an electric sander and have at it! After three minutes of work, you should have buffed the panel quite nicely. Now take a piece of 000 ("triple-aught") steel wool to the panel and remove any swirls left by the sander. At this point, your panel is probably starting to look pretty silky. We'll paint this guy in just a moment, but first we need to take an important intermission to clean it up.

Start off by washing the panel with ordinary soap and water. This will remove any grit or

debris left from the sanding and steel wool steps. Really suds it up well, and rinse it thoroughly afterwards. Give the panel a quick dry off with a soft towel.

We need to get rid of any remaining soap film or residue now. So, using cotton balls and 90% alcohol (available at any drug store), give the panel a thorough cleansing. The alcohol will remove any lingering soap scum completely. Let the panel air dry, then buff it down one more time with a soft, dry towel. Check for any lint or cotton ball strands before proceeding.

CHOOSE YOUR COLORS

The next step is to apply a layer of gray primer to the rack panel. The primer not only provides a good surface for the colored paint to stick to, but also tends to smooth out and fill in any minor imperfections. Be sure to read the label on the can so that you'll get the best possible results out of the gray primer.

Once the primer is dry, you can apply the colored spray paint layer. The top choice here is probably epoxy paint (the kind used on household appliances). Epoxy paint provides an extremely tough surface, immune to most chipping and scuffing. Again, be sure to follow the instructions on the can carefully, and allow plenty of drying time.

LABELING THE PANEL

Let's head back to the computer. Boot up your drafting program again, and load in your original layout. We'll use this to whip up some nice looking decals which will provide a legend for the various controls. Figure 7 gives the details. What you do is replace all of the representations (pots, jacks, switches, etc.) with black dots centered over each fitting. The reason for

CLEAN IT UP!

Go Wireless With Our Modules

<h3>SILRX/TXM</h3> <p>SILRX — \$26.00 ea. TXM — \$15.50 ea.</p> <p>The TXM and SILRX modules are a transmitter and receiver pair which can achieve a one-way radio data link-up to a distance of 200m over open ground.</p> <p>Both units are supplied in space-saving single-in-line packages and offer SAW controlled, wide band FM transmission/reception.</p> <p>The modules are particularly suited to battery-powered, portable applications where low power and small size are critical design criteria.</p> 	<h3>TX2/RX2</h3> <p>TX2 — \$19.50 ea. RX2 — \$38.50 ea.</p> <p>The TX2 and RX2 radio transmitter and receiver pair enable the simple implementation of a data link at up to 40kbit/s at distances up to 75m in-building and 300m open ground. Both modules combine full screening with extensive internal filtering to ensure EMC compliance by minimizing spurious radiations and susceptibilities. The TX2 and RX2 modules will suit one-to-one and multinode wireless links in applications including car and building security, EPOS and inventory tracking, remote industrial process monitoring, and computer networking.</p> <p>Because of their small size and low power requirements, both modules are ideal for use in portable, battery-powered applications such as hand-held terminals.</p> 
<h3>RPC</h3> <p>RPC — \$99.00 ea.</p> <p>The RPC module is an intelligent transceiver which enables a radio network link to be simply implemented between a number of digital devices. The module combines an RF circuit with processor-intensive low-level packet formatting and recovery functionality, requiring only a simple antenna and 5V supply to operate with a microcontroller or a PC.</p> 	<h3>BiM</h3> <p>BiM — \$69.00 ea.</p> <p>The BiM module integrates a low-power UHF FM transmitter and matching superhet receiver together with data recovery and TX/RX change over circuits to provide a low-cost solution to implementing a bi-directional short-range radio data link.</p> 

Lowest Prices!

Lemos International Co., Inc.

65 Southbridge Street, Auburn, MA 01501
Phone (508) 798-5004 ♦ Fax (508) 798-4782
www.lemosint.com ♦ lemosint@ma.ultranet.com
All products available in either 418 or 433 MHz

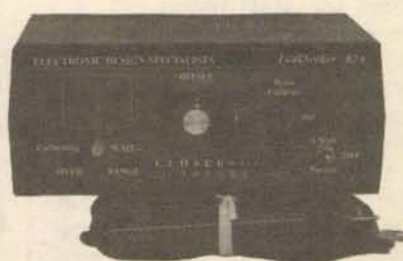
CHECK CAPACITORS IN-CIRCUIT WITH 100% ACCURACY



CapAnalyzer 88 \$179

- Automatically discharges cap;
- Checks for low DCR and shorts;
- Checks high-frequency ESR and displays on 20-segment LED meter
- 3-color chart shows typical values.
- Includes gold-plated tweezer probe
- Portable... Batteries included!

LOCATE ANY SHORTED or LEAKY COMPONENT TO THE EXACT SPOT



LeakSeeker 82A \$179

Locates shorted & leaky parts to the exact spot on the PCB without cutting up the board or unsoldering any parts!

- 60 DAY SATISFACTION OR MONEY BACK GUARANTEE
- AVAILABLE AT YOUR FAVORITE DISTRIBUTOR



ELECTRONIC DESIGN SPECIALISTS

4647 Appalachian St, Boca Raton, FL 33428 561-487-6103 www.eds-inc.com
we make test equipment designed to make you money.

this will become clear in just a moment. Now using the "cut and paste" command within your software, rearrange the major groupings so that they'll all fit on an 8-1/2-inch by 11-inch sheet of paper. If you're satisfied with how things look, print it out, using a laser printer for best results.

Take the page to your local photocopy shop and have the folks there reproduce it onto a sheet of clear sticky-back material. (This is a self-adhesive transparent plastic sheet which comes in either shiny or matte finishes.) Alternatively, if you have a stock of blank sticky-back sheets yourself, you could run them through your laser printer directly and skip the photocopying step.

Next, using a sharp razor or X-acto knife, cut out the decals in logical blocks. For example, in Figure 7, there are four logical blocks, or you could lump the top two together and the bottom two together. In any event, peel off the backing of the decal and press it down on the panel. The dots help you line it up over the holes you've already drilled. To avoid trapping air bubbles under the decal, it's usually best to start at one end and carefully work your way along the length of the decal. Then place a sheet of paper over the decal, and with the back of your thumbnail rub it down smoothly to press out any air bubbles.

At this point the decals cover everything, including the holes! So, with a pointed X-acto knife carefully cut out the center of each one. That is, stab the knife into a hole, then slide it around the perimeter trimming away the sticky-back material. When you make it all the way around, a disk will pop out which you then discard. Repeat for all of the remaining holes.

To really protect your handiwork, you need to apply a layer of clear plastic spray paint. But here's an important point. Spray it on in many, many thin layers (allowing time to dry between each layer), instead of several thick layers. This not only keeps the "ink" from running, but also prevents swirls and runs from rearing their ugly heads.

USING YOUR PANEL

Give the clear coat a couple days to really dry, and then you're all set to start building with your new rack panel. For most common circuits, you can simply mount the circuit board behind the rack panel on little angles. Figure 8 illustrates how to do this. (On the other hand, RF or high-voltage circuits should probably be housed in something that isolates them completely from the outside world.)

When you're all done with the wiring and testing, you can mount the completed unit in a cabinet. As mentioned earlier, if your cabinet has wooden rails you can use wood screws for this; tapped metal rails require a 10-32 machine bolt. If you have a choice of head type, pick the oval style. That way, you

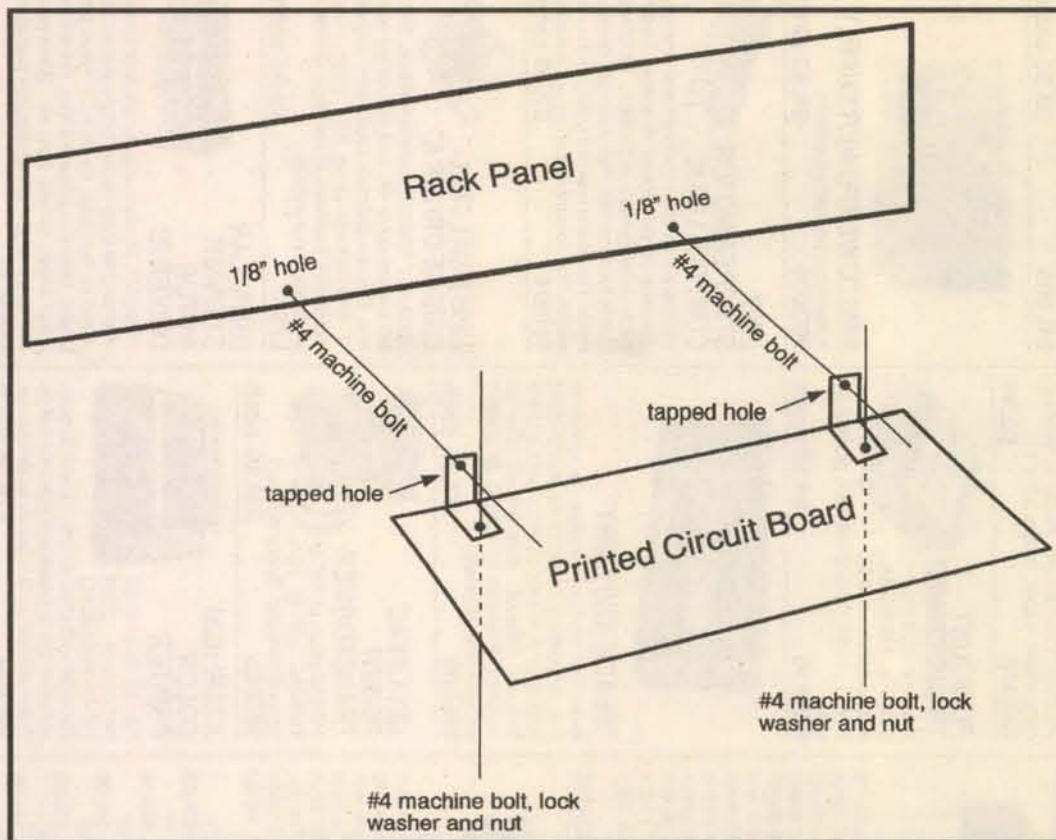


FIGURE 8: A printed circuit board mounts behind the front panel by means of two small angle brackets. The front holes of the brackets have been tapped to take #4 machine bolts, while the bottom holes accept #4 bolts, lock washers, and nuts.

can use cup washers between the screw or bolt and the front panel; the oval head "settles in" to the center of the cup washer quite nicely and looks very professional. They are available in several sizes and materials (brass, aluminum,

this process, I have had a steady stream of compliments from people on how attractive my gear appears.

If I (with a total lack of a background in art) can do it, then so can you! **NV**

RESOURCES BLANK RACK PANEL KITS

Blank rack panel kits are available from **Midwest Analog Products** in either 1U or 2U sizes. Each kit includes: blank aluminum rack panel, 1/8" thick tapped miniature angles zinc plated #4 machine bolts, lock washers and nuts

#K901 1U (1-3/4" by 19") Rack Panel Kit \$8.95
#K902 2U (3-1/2" by 19") Rack Panel Kit \$10.95

Note the following ordering information:
Minimum order of \$15.00. Please add shipping and handling of 10% of merchandise total or \$5.00

(whichever is less).

Shipping is by First Class Mail.

Prices shown in US dollars. Remit US funds only. Write

or E-Mail for shipping information to other countries.

MN residents add 6.5% sales tax.

Money orders and checks only.

Prices and terms subject to change without notice.

Free catalog available upon request.

Order from:

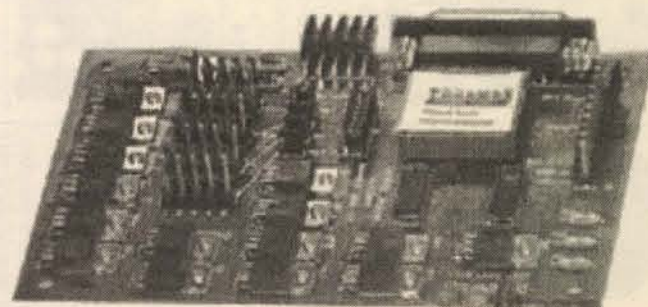
MIDWEST ANALOG PRODUCTS
P.O. Box 2101, N. Mankato, MN 56003
E-Mail: map@prairie.lakes.com
WWW: <http://prairie.lakes.com/~map>

ADDRESSABLE STEPPER MOTOR CONTROLLER

The PARAMAX stepper motor controller is a PC parallel port based addressable controller capable of simultaneous operation of 4 uni-polar stepper motors ranging in voltages from 5 to 12 volts at up to 2 amps per phase. The PARAMAX stepper motor controller includes 8 digital inputs with a data throughput rate of 500k bytes per second. Using the unique PARAMAX addressing method, up to 256 controllers can simultaneously function from a single parallel port. The programming package includes libraries that allow you to create applications both under Windows and DOS. Included libraries are: C++, Pascal, Delphi, Basic and utilities for DOS and Windows.

Also available at:
FORD ELECTRONICS, INC
(714) 521 - 8080

Part Number: JWP1X-1A
\$199.95



PARAMAX INC.
(800) 473 - 8080

Come and visit us on the internet at:
www.paramax.net

Think
Christmas!**TOMINON
HI-POWER
LENS**

1:4.5, f=230mm (9"), weight 4 lbs. Six coated symmetric glass lenses in black aluminum case, 3.625" dia. by 4.375" long. Scale range from 1:10 to 1:1 to 10:1. Originally cost over \$350.00. Unused.

92L034 \$29.95 each

**PRECISION
EYEPiece**

21mm f:3.5. Four coated lenses in black aluminum case measuring 1.5625" long by 1.0" diameter, 35° angle of view without vignetting.

92L031 \$4.95 each

TELESCOPE KIT

One Tominon High Power Lens (92L034) and one Precision Eyepiece (92L031) with documentation on how to build a wide field telescope.

96L004 \$35.00/set

**INFRARED
KIT**Do It
Yourself!

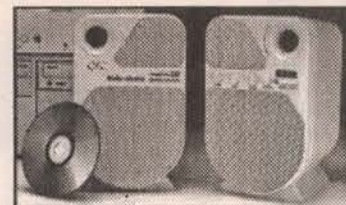
Includes part #97V012 (assembled transmitter unit with forty-seven buttons), detector unit, printed circuit board, detector amplifier IC, and all parts needed to detect the signal from the transmitter and convert it to a serial TTL signal.

93V010 \$19.95 each

**FUNCTIONALLY-
CHALLENGED
SIGNMAIL UNITS**

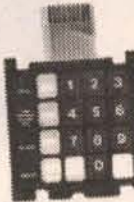
These units don't work! What you get are three sets each consisting of one 9V, 49.xxx MHz crystal-controlled FM transmitter, and a matching dual-conversion narrow-band FM crystal-controlled receiver/tone decoder/signal unit that runs on 6VDC. With documentation.

98Z011 Three for \$10.00

**AMPLIFIED
3-D MULTIMEDIA
SPEAKER SYSTEM**

Magnetically shielded 2-way speaker system with 2" tweeter and 4" woofer. 300W P.M.P.O. 4 Ohms impedance. Frequency range 20Hz-20MHz. Power LED/surround/bass/treble/volume controls. Dimensions 226mm H x 140mm W x 175mm D.

95V014 \$59.95/Pair

**MEMBRANE
KEYPAD**

5 x 4 matrix, approx. 3" sq., with adhesive backing.

97B014 99¢

RF SNIFFER

This useful kit is a wideband RF detector that indicates RF field strength in the 100kHz to 500MHz range at low levels. The kit includes an etched and drilled circuit board and all necessary components, except 9V battery. It also comes with a plastic case, antenna and an attractive analog meter.

The RF power reading is not linear and simply indicates the presence of RF and its relative level. However, it makes a great BUG detector or you can use it to test the output of any RF transmitter, including ham radios, cordless telephones and even car alarm transmitters! The circuit has an adjustable attenuator to handle everything from low to high power levels. Use during RFI/EMI precompliance testing. The kit is easy to assemble and comes with schematic diagrams and complete instructions.

97K005 \$29.00 each

**UHF LINEAR
AMPLIFIER**

Input: 1 dB. Freq. Range: 890 to 940 MHz. Gain: 17 dB. Bias: 18 VDC @ 100 mA. Wilmarco #730.

96V001 \$14.95 each

**OKI MOBILE
CELL PHONE**Gift for
Your Family's
Safety!

These new factory-boxed OKI 1200-series cellular phones are made in the USA. They have outstanding sound quality, memory to store up to 100 names and numbers you call most, ten one-touch dialing keys, and "911" dialing even when the phone is locked. They also have two NAMs to minimize your roaming charges. These phones have a user-friendly design that will mount vertically or horizontally, and the handset will mount on the dash/console. The transceiver mounts anywhere, from the trunk to under the seat. Use an external antenna for greater range.

OKI1200 \$25.00 each

**TWINKLING HOLIDAY
ORNAMENT KIT**

Ornament is 3" tall, small enough to hang on your Christmas tree or around your neck at a holiday party. Either way, it's guaranteed to attract attention.

97K006 \$18.00 each

**One-Pound Spool
FAMOUS BRAND
SOLDER**

60% Sn, 40% Pb, 0.050" diameter for electronics work.

92Z013 \$9.95

Other solders in stock, including rare alloys.

**EXTENSION
CORD
AND HOLIDAY LIGHT TESTER**

Indicates location of break in appliance or lamp cords, and tests all types of holiday light strands for locating defective bulbs. Safe and simple to use.

GVD-500ACS \$2.49

Give your fish
some fresh air!**AQUARIUM AIR PUMP**

On soft rubber base, approx. 3"W x 4.25"L x 1.875"H.

94U020 \$7.95 each

Super
Gift!**EASY PIC'N
v3.0**

By David Benson
A beginner's guide to using PIC 16/17 microcontrollers. From "Square1," 161 pp., 8.5" x 11".

98X006 \$29.95

**GOBS OF GOODIES!
Studioline Stereotrack II
Cable TV Adapter**

Separates stereo signals from the cable TV input, feeds RF signals to TV/VCR tuner and stereo signals to FM (either RF or fixed/variable level audio). Hundreds of useful parts which may be removed for audio/RF projects. Controller board has CPU and socketed EPROM as well as Mitsumi varactor tuner, cable/FM separator board, regulated power supply subassembly, channel select board, and stereo separation output board. Black metal case, 14" x 10" x 3". Sold for experimental purposes only. With documentation.

92V020 Two for \$39.95

**RACK MOUNT CABINETS**

These high-quality rackmount enclosures come in an attractive charcoal grey epoxy finish. The top, bottom and sides have ventilation holes to assist in cooling. The front and back panels are made of 0.059" thick aluminum for easy custom design. The top, bottom and sides are 0.035" steel. Choose from six sizes. All include handles except RC3120A.

RC3120A - Front panel 19" x 1.6875"
1.5"H x 16.625"W x 9.625"D - \$38.00
RC3120B - Front panel 19" x 3.4375"
3.25"H x 16.625"W x 9.625"D - \$46.00
RC3120C - Front panel 19" x 3.4375"
3.25"H x 16.625"W x 13.1875"D - \$53.00
RC3120D - Front panel 19" x 5.1875"
5"H x 16.625"W x 13.1875"D - \$58.00
RC3120E - Front panel 19" x 5.1875"
5"H x 16.625"W x 16.75"D - \$63.00
RC3120H - Front panel 19" x 8.6875"
8.5"H x 16.625"W x 16.75"D - \$83.00

New!
Y2K!**EMERGENCY
SURVIVAL
COMMUNICATIONS**

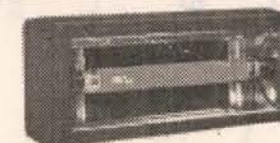
How to Build and Power Your System
Keys to survival news. Shortwave radio. World of amateur radio. Scanning. CB/Citizens Band. Personal communications systems. Satellite radio and guide. Alternate power sources. Free playing radios. Weather information. Radio antennas. Source lists. paper, 182pp, 8.5 x 11.

98X008 \$9.95

**PC MOUNT
TRANSFORMER**

Primary: 115/230V, 50/60Hz, 180/90mA.
Secondary: 15/30VCT, 14VA. Wiring diagram printed on unit.

98N010 \$4.95 each

**"BLACK (UV) LIGHT"**

Avon "Derma-Spec" imager designed for skin evaluation, but ideal for many other applications. Plastic case contains a UV-B bulb and reflector. Auto turn-off after 50 seconds. Powered by 12VDC @ 500mA wallwart (not included).

98L009 \$7.95 each

**12/14.5VAC
POWER
TRANSFORMER**

110VAC input. 12VAC or 14.5VAC out @ 25A (tapped primary). Specs included.

98E005 \$29.99 each

**ATARI 1020
COLOR
PRINTER**

For all Atari 8-bit computers. (Not PC-compatible!)

Package includes: printer, power supply, software, pens, paper and interface cable. These are new units in factory sealed boxes.

94C037 \$14.95 each

**TV AUDIO DEMODULATOR**

Unused unit from cable TV box takes channel 3, 4 or 5 signal and demodulates the audio. Comes with documentation and schematics, plus additional schematics to build add-on video demodulator board.

92A028 \$9.95 each

**DELUXE KEYCHAIN LASER**

High quality laser pointer sports attractive finish. Projects plain beam and four designs up to 1000 feet on three tiny LR44 1.5V watch batteries (included). Weighs in at only 0.6 OZ. 645nm 5mW, class IIIA.

98L008 \$9.95 each

**MINI TOWER POWER SUPPLY**

Pulled from unused equipment.

96C009 \$9.95 each

**L297
STEPPER MOTOR
CONTROLLER IC**

Normal/Wave drive. Half/full step modes/Clockwise/anticlockwise direction. Switch mode load current regulation. Programmable load current. Few external components. Reset and enable inputs, and home output. Full documentation on our website.

95I004 \$7.90 each

**L298 DUAL FULL-
BRIDGE DRIVER IC**

Up to 46V operating supply voltage. Total DC current up to 4A. Low saturation voltage. Overtemperature protection. Logical "0" input voltage up to 1.5V (high noise immunity). Multiwatt-15 package. Docs are available at our website.

L298 \$9.95 each

**UNIPOLAR
STEPPER
MOTOR
DRIVER IC**

UCN5804. Drives a unipolar stepper in one of three operating modes: single phase, two phase or half step. Up to 1.25 Amps per phase. Step and direction input. Drive with a 555 timer, parallel port, etc. Build your own robot, anything that requires precision positioning.

93I002 \$4.50 each

**AIRPAX
PULSE MOTOR**

7.5°/step, 48s/rev., 12VDC, six-wire. Airpax #LA82407, with spec sheet.

92M010 \$3.95 each

COMBO PACK!

One 93I002 IC and 92M010 motor (both shown above) with schematics.

93I003 \$7.95/set

Send \$2.00 For Our Latest Catalog!

\$4.00 Foreign. Refundable on First Order.



Store Hours: 9-6 M-F & 10-3 Sat. - Pacific
Visa, M/C, AmEx Accepted.

All Sales Final.

California Residents Add Sales Tax.

Shipping Additional on All Orders.

Prices Good 60 Days from Date of Publication

ALLTRONICS

2300-D Zanker Road - San Jose, CA 95131-1114

World Wide Web: <http://www.alltronics.com>

(408) 943-9773 - Fax (408) 943-9776

Open Channel

Antenna Gain and Pattern Measurements

by Joseph J. Carr

One way to characterize radio antennas is by their radiation pattern. When a signal propagates from an antenna, it radiates in some directions more than others. A theoretical construct called an isotropic source is a spherical point source that radiates in all directions. An antenna shows an apparent increase in power in preferred directions because the power that is spread over the isotropic surface is concentrated in the preferred direction. This is the gain of the antenna. The gain of an antenna in any given direction is found essentially by comparing the signal strength in that direction to the signal strength of the same unit area on the surface of the radiating isotropic source. This is called gain over isotropic, and is expressed in decibels (dB).

When we make a map of the gains in all directions, we have the radiation pattern of the antenna. The overall radiation pattern is a solid, three-dimensional geometric figure, so we often take horizontal

("azimuthal") and vertical ("elevation") slices out of the pattern and present them as representative of the whole.

Figure 1 shows the radiation pattern for unidirectional Yagi-uda array designed for 151 MHz, where it can be used for solar noise detection. Ideally, the Yagi-uda is unidirectional, but "real world" antennas are not so fortunate. In this case, there is a considerable back lobe and several side lobes in addition to the main lobe. Any lobe in an unwanted direction results in wasted power (lower signal strength on target), greater possibility of interfering with other stations and (because of antenna reciprocity), more noise and interference on receive. Clearly, the antenna designer and user needs to know the nature of the azimuth and elevation patterns.

Outdoor Tests

Figure 2 shows an outdoor method for measuring the antenna

radiation pattern. It is fraught with difficulty, but is sometimes the only means available for a particular antenna or location. Although it's best to use an indoor antenna range (discussed below), those facilities are both expensive and frequency limited. All such facilities have a lower frequency cut-off limit, below which it will not work properly.

In Figure 2, the antenna under test (AUT) is mounted to a rotator assembly.

A distant source, perhaps a distant on-the-air radio station, is used to provide a signal source. The signal source must be in the far-field, i.e., where the power density falls off according to the inverse square law ($1/D^2$). The pattern can be obtained by rotating the antenna through a 360-degree arc, and measuring the signal strength at points along its arc of travel.

This process is easy, intuitive, and inherently appealing. But it is also problematical. For one thing, in the off-the-air variation on this theme, there is no guarantee that the output power of the distant radio station is constant during the time the antenna is rotating.

Some of the ambiguity can be

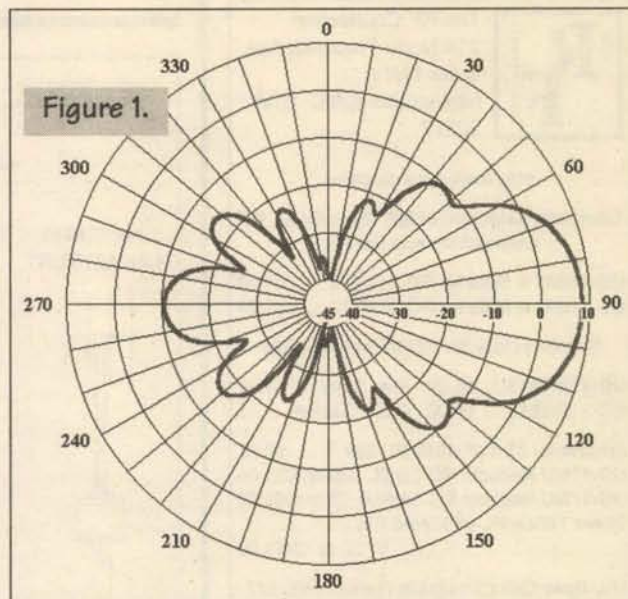
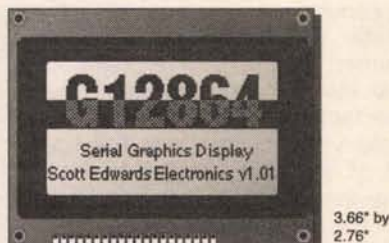


Figure 1.

taken out of the outdoor test approach by using a known reference signal, rather than an off-the-air signal. If a signal is generated, and controlled to maintain a constant output level, then part of the problem is solved. In general, the best approach to having the signal provide uniform illumination of the antenna is to radiate it from a location outside the near field of the antenna, from a transmitting loop antenna that is small compared with the wavelength of the signal being emitted. A loop that is $<0.15\lambda$ has the attribute of exhibiting a constant current throughout the conductor. Larger loops, and other forms of antenna, have a varying current distribution along the length of the

Scott Edwards Electronics

NEW! Graphics LCD Module with Serial Interface



The new G12864 makes it easy to display text and graphics on a 128-by-64-pixel LCD. It interfaces with a computer through a 2400 or 9600-baud RS-232 serial hookup.

Text Features

The G12864 works like a serial-receive terminal. It displays text in a 4-line by 16-character format. Text is displayed in a large 8- by 16-pixel font, which can be edited to include custom symbols.

Graphics Features

The display lets you plot points, draw lines, and display full-screen graphics using easy instructions. Its flash memory stores the text font plus 14 screens. You can create fonts and graphics on your PC, then download them to the G12864 using the included software.

Convenience Features

A power supply and DB9 serial-port connector are built in. Connect the display to the (included) AC adapter; plug the (included) serial cable into your PC or other computer, and you're ready to go. Current draw ranges from 15mA (typical, backlight off) to 100mA (max, backlight on). For complete specifications, see our web site: www.seetron.com.

Display, with starter pack: \$199 Display alone (OEM qty 1): \$179

Scott Edwards Electronics • PO Box 160 • Sierra Vista • AZ • 85636-0160
ph: 520-459-4802 • fax: 520-459-0623 • e-mail: info@seetron.com
Internet: www.seetron.com

Write in 86 on Reader Service Card.

100 WATT AUDIO AMP

GROMMES-PRECISION ST100E AUDIO AMPLIFIER, solid state 100 watt public address amp; response 35 to 20000 Hz 4 ohm output, 0.3% distortion. Volume controls for MIC-1 & -2, AUX input, MUSIC and MASTER plus BASS and TREBLE controls. Also slide switches Loudness bass boost and Lo Filter plus Peak Power/Over-load indicator. Back panel outputs for 4 to 8 ohm and 25 or 70 V speakers, Booster Amp, Mute, 600 ohm telephone line page, two Lo or Hi Z mic select, two XLR 3-pin male mic connections and AC accessory outlet. 4.3x15x12.8, 25 lbs sh. NEW, \$249.50

1950's CAR TACHOMETER

HEYER MODEL 337 TACH / VOLTMETER with 4.5" chrome-rimmed meter. ranges 0-1000 & 0-5000 RPM and +/- 0-18 VDC. Amplifier button plus socket for timing light. With tubes 0A2 & 2D21; 6 or 12 VDC use. Nice addition to a car collector's display! 13x5x5, 9 lbs sh. UNUSED, not tested, \$24.95

1 to 1400 MHz Sweeper

WAVETEK 2001A SWEEP GENERATOR, covers 1 to 1400 MHz sweep and CW in bands 1-500, 450-950, and 950-1400 MHz. Sweep width 50 KHz to 500 MHz. Sweep time: 100 to 0.01 S in 4 decade steps. Markers at 0.2, 1.5 and 20 MHz harmonics and single frequencies 63 MHz, +/-0.35 and +/-0.9 MHz. Marker width 15-400 KHz in 4 steps. RF output continuously adjustable +9 to -81 dBm into 50 ohms. Requires 115/230 VAC 50-60 Hz; 5.3x 11x14.2, 25 lbs sh. USED-repairable w/book, \$395.00

30 FT ANTENNA MAST

AB-1244/GRC MAST KIT, twelve aluminum alloy on steel sections form sturdy, yet lightweight 30 foot 1.7" dia mast. Kit includes five each lower and upper sections, one ea lower and upper adapter sections, gin pole swivel base, four ea 36 and 42 ft guy ropes, four guy stakes, two guy rings plus a 2.5 pound sledge hammer. Part of OE-254/GRC antenna set; 30 lbs. NEW, \$139.50

Prices F.O.B. Lima, Ohio. VISA, MASTERCARD accepted.

Allow for shipping charges. Write for latest Catalog.

Address Dept. NV + Phone 419/227-6573 + FAX 419/227-1313

E-mail: fairradio@wcoil.com Home Page: <http://www2.wcoil.com/~fairradio>

FAIR RADIO SALES CO.
1016 E. Eureka + Box 1105 + Lima, Ohio 45802

Write in 87 on Reader Service Card.

Nuts & Volts Magazine/December 1998 77



The RF Connection
213 North Frederick Ave.
Suite 11NV
Gaithersburg, MD USA
20877

<http://www.therfc.com/>

Complete Selection of MIL-Spec Coax, RF
Connectors and Relays

UG-21B/U N Male for RG-213/214.....\$5.00
UG-21D/U N Male for RG-213/214.....\$3.25

N Connectors for 9913/Flexi4XL/9096

UG-21B/9913.....\$6.00 Pins Only.....\$1.50
UG-21D/9913.....\$4.00 Extra Gasket......75

Amphenol 83-1SP-1050 PL-259.....\$0.90
UG-176/U Reducer RG-59/8X .25 or 5/\$1.00
UG-175/U Reducer RG-58/58A .25 or 5/\$1.00
Silver Teflon PL-259/Gold Pin.....\$1.00 or 10/\$9.00

MIL-Spec Coax Available (Teflon, PVC IIA)

New Product: Belden 9913F. 9913 with
High Density PE Foam dielectric, stranded
center cond. and Duobond III Jacket.....
.....80/ft or \$76.00/100ft

Also New: 9092, RG8X with Type II Jacket
Intro Price.....\$23.00/100ft

Call for Specials of the Month

Full Line of Audio Connectors for Icom,
Kenwood, and Yaesu

8 Pin Mike Female.....\$2.50
8 Pin Mike Male Panel.....\$2.50
13 Pin DIN for Kenwood.....\$2.75
8 Pin DIN for Icom.....\$1.00
8 Pin DIN for Kenwood.....\$1.50

Prices Do Not Include Shipping

Orders 800/783-2666
Info 301/840-5477
FAX 301/869-3680

Write in 88 on Reader Service Card.

ELECTRONIC TOOLS ETC.

TWEEZERS, FORCEPS, SCISSORS

* PROBES (DENTAL PICKS)

* DREMEL TOOLS, ROTARY

TOOL EQUIPMENT

* OPTICAL AIDS (MAGNIFIERS)

* SCREWDRIVERS, TIPS, BITS

* PLIERS, ALL SHAPES, SIZES

* NEW, HARD TO FIND

TOOLS EVERYDAY

TOLL FREE: 1-888-UTOPIA-2

SAVE
\$
HERE!

UTOPIA
TOOLS

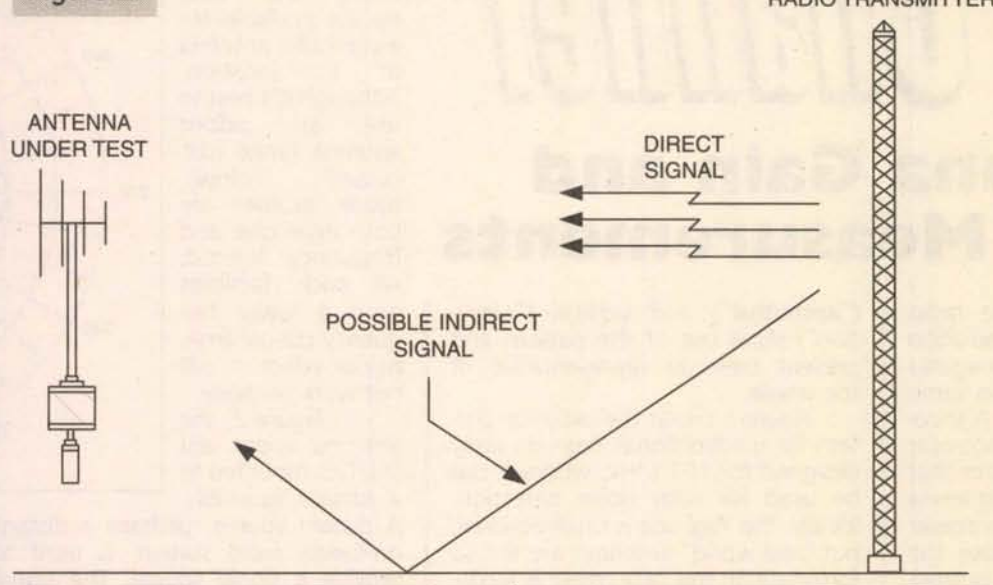
CALL OR WRITE
3899 BARNARD DR.
APT. #519
OCEANSIDE CA
92056

CALL:
(760) 439-6682
FAX:
(760) 439-6682

CALL NOW FOR FREE CATALOG

Open Channel

Figure 2.



antenna radiator.

Also, unless it is a broadcasting station, it is likely to go on and off the air with use rather than emitting a constant signal. In the high frequency shortwave bands, this problem can be especially acute because of fading mechanisms afflicting even groundwave signals. With skywave sources (ionospheric propagation aka "skip") it is insanely difficult to account for!

Another problem is unwanted signal paths. Normally, one hopes that only the direct space wave is received. That would make the problem easier. But in real environments there may be additional paths. In Figure 2, a ground reflection is shown. It is sometimes easy to overcome these by being aware of their source and adjusting the data accordingly. Unfortunately, nice static ground reflections are not the only sort found. Especially at VHF/UHF, there may be transient reflections due to passing ground vehicles and aircraft. Supposedly, sometimes even good-sized birds can be a problem.

All in all, the outdoor method is perilous, at best. But before moving on to discussing the indoor range approach, let's take a look at a quick and dirty approach to making gain

measurements.

Figure 3 shows two antennas pointed at the same distant source. It is relatively easy to achieve a reasonable approximation of the antenna gain by comparing it to a reference antenna. For most purposes, either a half wavelength dipole or a quarter wavelength vertical antenna is preferred for the reference antenna.

The basic procedure is simple and straightforward. Let's assume that the AUT has a higher gain than the reference dipole. Set S1 to measure the signal strength coming from the reference antenna. Next, switch S1 to the AUT and again measure the signal strength.

If the receiver used has the ability to accurately measure the two signal levels, then a gain determination can be made. If the receiver is merely a communications receiver with an S-meter, then there may be problems if either: a) the S-meter calibration scale factor is unknown, or b) the scale factor changes over the range (some S-meters compress the upper end of the scale, so the difference between S8 and S9 is fewer decibels than the difference between, say, S1 and S2, despite the fact that both are "one S-unit"). In that case, a modified procedure is used:

1. Set S1 to measure the signal strength from the reference dipole.

2. Set S1 to measure the signal strength from the AUT (it should be higher).

3. Adjust the precision attenuator in the transmission line from the AUT until the S-meter reads exactly the same as it did for the reference dipole.

One instruction for this method took note of the fact that the signal levels might vary over time, so switching between antennas can introduce error. The problem is partially solved by switching the antenna at

a slow enough rate to capture the data, and taking a large number of samples (e.g., one per second over several minutes) and averaging the results.

Indoor Range

If the funds and facilities are available, then an indoor antenna range (Figure 4) is preferred. The data collected are of far greater usefulness than the data collected out-of-doors, especially off-the-air. The indoor range is simply a more easily controlled, predictable environment.

The indoor range consists of a room lined with materials that absorb radiowaves. Usually in the form of pyramid-shaped wedges, various sizes of absorbers are placed over all surfaces of the chamber. The room is inside of a Faraday cage. This shielding provides protection against both signals from outside interfering with the test, and reflections of the reference signal from structures outside of the chamber. A point source, such as a small loop at UHF and below, or a horn radiator at microwave frequencies, is positioned at one end of the room.

The antenna is mounted on a rotatable pedestal. In order to

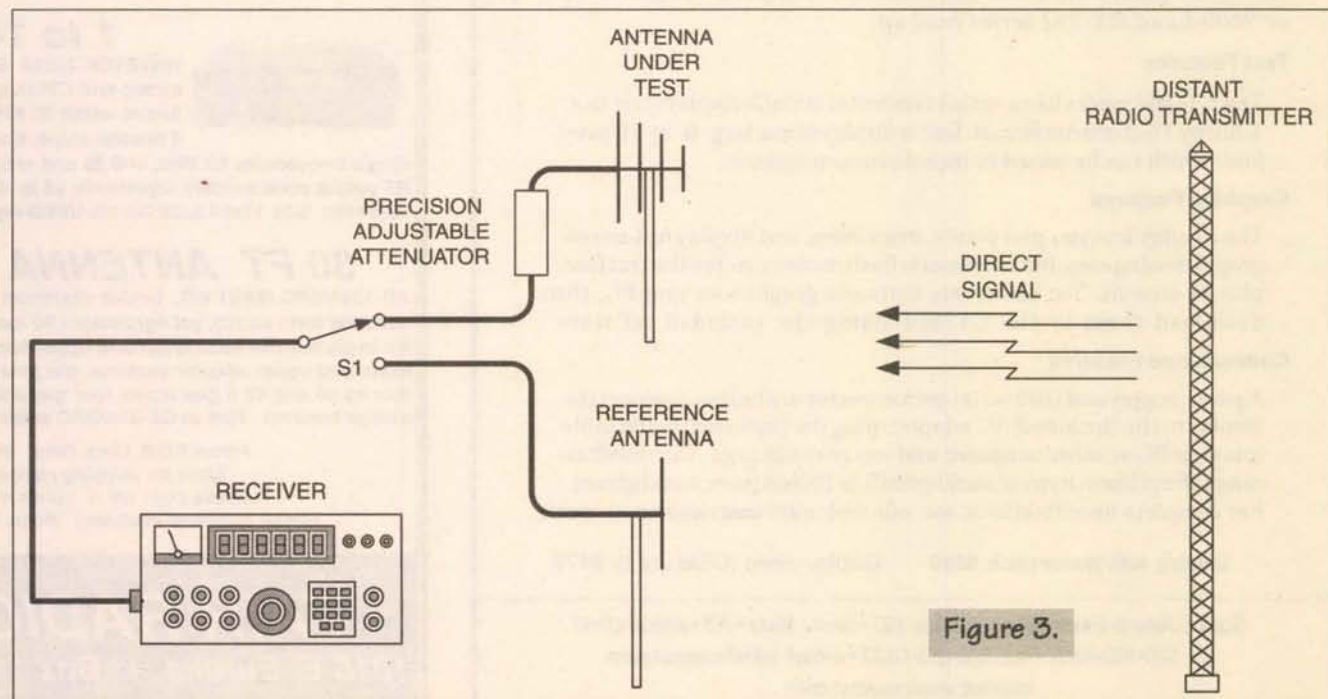


Figure 3.

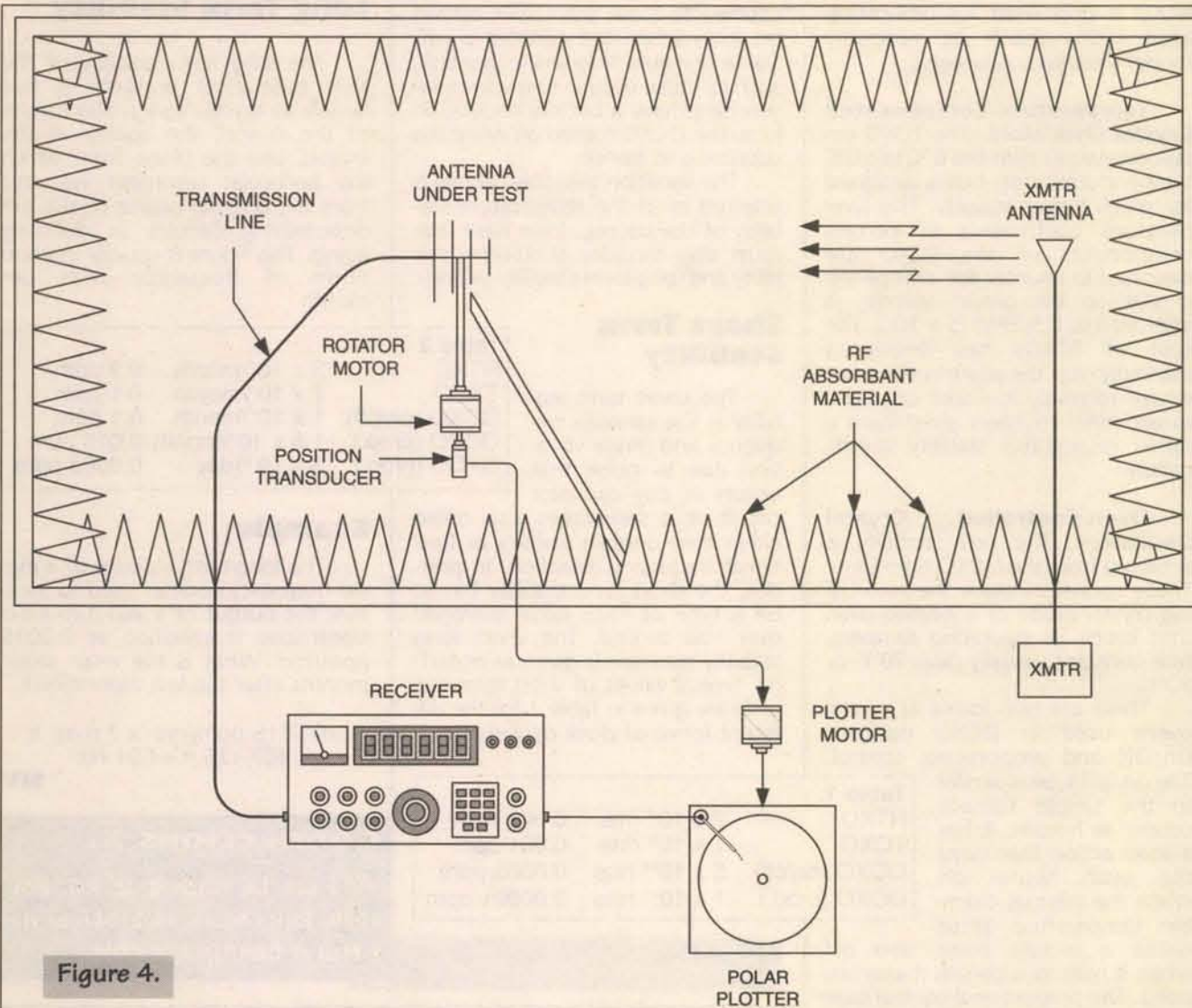


Figure 4.

prevent secondary reflections from the pedestal, it is often the case that blocks of absorbent material are used to block the view of the pedestal from the radiator. Both elevation and azimuth plots can be made by the simple expedient of mounting the antenna in the correct plane for each test.

The polar pattern of the antenna is created by using a servomotor or position transducer to rotate a chart recorder that measures the output strength of the receiver. The result is an antenna position-signal strength plot similar to Figure 1.

Modern versions of the indoor range use a computer rather than the polar plotter shown in Figure 4. The output of the receiver is a voltage indicating signal level, so it can be A/D converted for input to the computer. The position transducer can also provide data to the computer. Once these data are in, a plotting program can draw the polar plot.

One advantage of the computer approach is that a static profile of the chamber can be made by mounting a reference antenna in place of the AUT. The plot can then be made, and note taken of any reflections or other anomalies that exist in the chamber. These data can then be compared with the data for the AUT at each angle, with the AUT data adjusted to account for directional differences.

Antenna Modeling

Antenna chamber time can be expensive, so the trend today is to model the antenna performance on

the computer before doing any actual building and testing. At one time, it was common to perform range tests, and then tweak the antenna design to improve the performance (often with inconsistent results). Antenna modeling provides a lower

cost approach to tweaking performance, with range time reserved for final confirmation. I have discussed antenna modeling in this column in the past. My own modeling is done with the Nittany-Scientific Nec-Win Basic program.

Other Ways to Solve the Problem

There are a couple of other ways to find the antenna pattern, or at least a rough approximation of it. For many years, radio broadcasting stations were required to do "proof of performance tests" that showed the radiation pattern. As part of the initial construction of the station, they would go to specified points on a map, and measure the field strength. If enough points "all around the compass" are measured, then a rough approximation of the pattern is made.

The AM broadcast band station is one area where this must be done. Antennas are hundreds of feet high, so are not very easy to measure in chambers! Besides, the point is the "installed" behavior, not the in-chamber behavior. This same thing can be done by amateurs and others. Use a topographic map (not a road map). These are available from the US Geological Survey. They have stores in locations around the country, and their products are also sold by commercial map dealers. Locate the antenna on the map, and make a dot.

Next, take a drawing compass, and spread the arms to make a radius equal to one mile on the map. Draw a circle with the antenna location at the center. Next, pick 30 to 60 points along the circle, and then travel there and measure the signal strength. Crude? Yes, but a reasonable idea of the antenna pattern can be obtained.

Another method for measuring the antenna pattern was used by a friend of mine down in Texas. Johnnie owned a small farm (43 acres) that he used for making antenna experiments. He also owned a 1946 Taylorcraft airplane. It was a kit-built variation on the Piper Cub style design. He owned a Stoddard field

ACP's 89th GIANT COMPUTER SWAP★MEET

Orange County's Original! All Day Sunday 8am-2pm Jan 31st FREE Admission & Parking Shop 100's of Sellers

in ACP's Giant Parking Lot !!!

Advanced Computer Products, Inc.

ACP SUPER★STORE Since 1976

1310 E. Edinger Santa Ana, CA 714-558-8813



When Visiting Disney World And Sea World... Come To The World Of Electronic Surplus!

SKYCRAFT

PARTS & SURPLUS, INC.
ORLANDO, FLORIDA



Located At The Intersection Of I-4 And Fairbanks Avenue.

Self-Service Retail Outlet Featuring Commercial And Government Electronic Surplus Including:

- | | |
|--------------------|-----------------------|
| ★ WIRE | ★ COAX |
| ★ SWITCHES | ★ RELAYS |
| ★ RESISTORS | ★ HARDWARE |
| ★ TRANSISTORS | ★ CAPACITORS |
| ★ TRANSFORMERS | ★ PANEL METERS |
| ★ TEST EQUIPMENT | ★ CIRCUIT BOARDS |
| ★ NI-CAD BATTERIES | ★ INTEGRATED CIRCUITS |

HOURS:

Monday - Friday 8:30-6:00
Saturday 8:30-5:00

★★★★★★★★

We Buy Surplus Electronic Parts — FAX your list.

FAX 407/647-4831

PH 407/628-5634

P.O. BOX 536186

ORLANDO, FLA. 32853-6186



strength meter that could be set in the passenger's seat. John would fly a circular route around his farm, about five miles out, with the field strength meter tuned to the transmitter frequency.

He would use a handheld two-meter walkie-talkie to ask a friend at his home station to key the transmitter that excited the test antenna. When the transmitter came up, he would mark his location and the FSM reading on the map.

Crystal Oscillator Accuracy and Stability

In the past several months, I've answered several questions on crystal oscillator specifications for the readers of this and other publications. The terms that seem to be most popular are accuracy and stability. The accuracy is the measure of the difference between the design or marked frequency and the actual frequency. Accuracy is measured in parts per million (PPM) or percent. A Citizen's Band transmitter is supposed to be within 0.005 percent of the design frequency, which is the same thing as 50 PPM. At 27 MHz, that works out to $\pm 1,350$ Hertz.

The stability of the oscillator will profoundly affect the accuracy over time. With respect to accuracy and stability, there are three basic categories of crystal oscillator: room temperature crystal oscillators (RTXO), temperature-compensated crystal oscillators (TCXO), and oven-controlled crystal oscillators (OCXO).

Room Temperature Crystal Oscillators. The RTXO takes no special precautions about frequency drift. But with proper selection of crystal cut, and reasonable attention to construction, stability on the order of 2.5 parts per million (PPM), 2.5×10^{-6} , over the temperature range 0°C to 50°C is possible. The

RTXO is only used for non-critical applications (such as economy model frequency counters).

Temperature-Compensated Crystal Oscillators. The TCXO circuit also works over the 0°C to 50°C temperature range, but is designed for much better stability. The temperature coefficients of certain components of the TCXO are designed to counter the drift of the crystal, so the overall stability is improved to 0.5 PPM (5×10^{-7}). The cost of TCXOs has decreased markedly over the years to the point where relatively low-cost upgrades to economy counters gives them a rather respectable stability specification.

Oven-Controlled Crystal Oscillators. The best stability is achieved from the OCXO time base. These oscillators place the resonating crystal inside of a heated oven that keeps its operating temperature constant, usually near 70°C or 80°C .

There are two forms of crystal ovens used in OCXO designs: On/Off and proportional control. The on/off type is similar to the simple furnace control in houses. It has a snap action that turns the oven heater on when the internal chamber temperature drops below a certain point, and off when it rises to a certain maximum point. The proportional control type operates the heating circuit continuously, and supplies an amount of heating that is proportional to the actual temperature difference between the chamber and the set point. The on/off form of the oven is capable of 0.1 ppm (10^{-7}).

OCXOs that use a proportional control oven can reach a stability of 0.0002 PPM (2×10^{-10}) with a 20-minute warm-up and 0.0001 PPM (1.4×10^{-10}) after 24 hours. It is common practice to design the

counter to leave the OCTX turned on even when the counter is off. Some portable frequency counters, such as those used in two-way radio servicing, have a battery back-up to keep the OCXO turned on while the counter is in transit.

The variation described above is referred to as the temperature stability of the counter time base. We must also consider short-term stability and long-term stability (aging).

Short Term Stability

The short term stability is the random frequency and phase variation due to noise that occurs in any oscillator circuit. It is sometimes also called either time domain stability or fractional frequency deviation. In practice, the short term stability has to be a type of RMS value averaged over one second. The short term stability measure is given as $\sigma(\Delta f/f)$ (t). Typical values of short term stability are given in Table 1 for the different forms of clock oscillator.

Table 1

RTXO	2×10^{-9} rms	0.002 ppm
TCXO	1×10^{-9} rms	0.001 ppm
OCXO (on/off)	5×10^{-10} rms	0.0005 ppm
OCXO (prop.)	1×10^{-11} rms	0.00001 ppm

Long Term Stability

The long term stability of the time base clock oscillator is due largely to crystal aging. The nature of the crystal, the quality of the crystal, and the plane from which the particular resonator was cut from the original quartz crystal are determining factors in defining aging. This figure is usually given in terms of frequency units per month.

Table 2

RTXO	3×10^{-7} /month	0.3 ppm
TCXO	1×10^{-7} /month	0.1 ppm
OCXO (on/off)	1×10^{-7} /month	0.1 ppm
OCXO (prop.)	1.5×10^{-8} /month	0.015 ppm
OCXO (prop.)	5×10^{-10} /day	0.0005 ppm

Example

The long-term stability of a digital frequency counter used to measure the output of a 467.125 MHz transmitter is specified as 0.0015 ppm/mo. What is the error seven months after the last calibration?

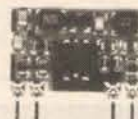
$$\pm 0.0015 \text{ ppm/mo.} \times 7 \text{ mos.} \times 467.125 = \pm 4.91 \text{ Hz}$$

NV

Connections ...

I can be reached at P.O. Box 1099, Falls Church, VA 22041, or via E-Mail at CARRJJ@AOL.COM.

RF Data Modules



AM TRANSMITTER

- Small size: 17.78 x 11.43mm
- CMOS/TTL input
- No adjustable components
- Low Current: 4mA typical
- 418MHz or 433.92MHz OOK
- Simple to integrate - simply add antenna, data and power
- Range up to 250ft.
- Wide supply range, 2-14Vdc
- SAW controlled - stability
- Also available in DIL package



AM RECEIVER

- Compact size: 38.1 x 13.7mm
- On-board data recovery. CMOS
- Low current. 2.4mA typical
- 2kHz data rate. CMOS/TTL output
- 5Vdc operation
- On 418MHz or 433.92MHz (4xx)
- No adjustable components
- Patented Laser Trimmed component
- High stability
- Sensitivity: -105dBm
- Available also in 0.8mA version



FM TRANSCIVER

- Only 23 x 33 x 11mm
- Up to 40k bps data rate
- 19200 baud with ASCII
- Up to 500ft. range
- 5v operation
- 0.25mW into 50
- 418 or 433MHz FM
- Fast 1ms enable
- Direct interface to 5V CMOS
- Auto TX/RX changeover

AM-RT5 \$12.10

AM-HRR3-4xx \$10.95

BIM-4xx-F \$87.36

RS232 TRANSCIVER MODULES



- 4,800 to 38,400 bps half duplex
- 3-wire RS232 interface
- μ Controller with user EEPROM
- RS232 interface protected to $\pm 15\text{kV}$
- Data packetizing performed by user
- Auto TX/RX changeover
- 418 MHz and 433MHz versions
- Range up to 500ft. (0.25mW ver.)
- 0.25mW & 10mW versions
- Reset switch and status LED's
- 7.5-15V dc via DB9 connector, 20mA

BIM-4xx-RS232 \$139.30



- Up to 19,200 bps half duplex
- 3 wire RS232 interface
- Range up to 500ft
- Transparent data packetizing
- Supports 8 or 9 bit protocols
- Self test function
- Reset Switch & Status LED's
- 1/4 wave wire antenna on board
- Available in a Simplex Tx/Rx pair (RTcomTX & RTcomRx)
- 7.5V-15Vdc operation

Transceiver.....
Transmitter.....
Receiver.....

RTcom-4xx..... \$247.90
RTcomTx-4xx..... \$ 87.15
RTcomRx-4xx..... \$105.52



ABACOM
TECHNOLOGIES



Tel: (416)236-3858
Fax: (416)236-8866
www.abacom-tech.com
abacomtech@compuserve.com

ATTENTION CABLE VIEWERS

CABLE VIEWERS... get back to your **BASIC** Cable Needs

Call 1-800-577-8775

For information regarding all of your **BASIC** cable needs.

5 GOOD REASONS TO BUY OUR FAR SUPERIOR PRODUCT

- PRICE
- EFFICIENT SALES AND SERVICE
- WE SPECIALIZE IN 5, 10 LOT PRICING
- ALL FUNCTIONS (COMPATIBLE WITH ALL MAJOR BRANDS)

ANY SIZE ORDER FILLED WITH SAME DAY SHIPPING

We handle NEW equipment ONLY - Don't trust last years OBSOLETE and UNSOLD stock!
COMPETITIVE PRICING - DEALERS WELCOME

It is not the intent of B.E.S.W. to defraud any pay television operator and we will not assist any company or individual in doing the same.
Refer to sales personnel for specifications.

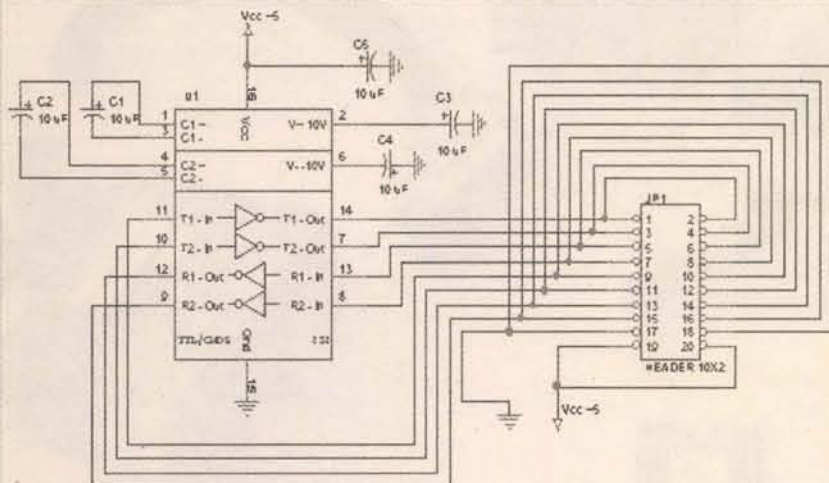
P.O. BOX 8180 • BARTLETT, IL 60103-8180 • 847-584-2099



BASIC
ELECTRICAL
SUPPLY &
WAREHOUSING
CORPORATION

TECH FORUM

Continued from page 66



ANSWER TO #10983 - OCT. 1998

DEC terminals are a little non-standard, but quite usable for the task at hand. My experience has been with the VT100-320, but I'll wager they're quite compatible.

The D-Type connector is probably a DEC standard DE-9. It will probably be easiest to just solder in the right angle connector [Jameco lists three different depths measured from the base of the connecting portion to the first row of pins, the depths are .318", .450", .590"; they are 8 to 59 cents each.]

Unlike IBM, DEC kept the critical pins 2, 3, and 7 at those same pin numbers when converting from 25-pin to 9-pin adapters.

To convert it to a DTE, the following pinouts are used:

DEC 9-PIN > 25-PIN ADAPTER	
9-PIN SIDE	25-PIN SIDE
2	3
3	2
4	5
5	6
7	7
6	20

The DEC-type connector you inquired about is an RS-422 port. It is just a standard six-pin modular jack with its tab offset so you can't accidentally plug in a phone line.

The crimp-on plugs for this were hard-to-find and expensive in it's heyday. I doubt it would be worth the effort. But if the soldering is intimidating, you can produce one of these connectors by shaving the tab off a standard six-pin mod plug.

The outputs from the plug are differential. So you will have to tie T- and R- together to make a Signal Ground, and use T+ and R+ as Tx and Rx. A small, well-stretched piece of electrical tape applied around the body of this plug should "fatten it up" enough to stay securely in the hole.

Once you have the terminal typing back and forth with your computer [through a null-modem cable if you used the DE-9 converter]. The rest is a snap.

All you need is a serial line level converter like the famous MAX232. This converts the 0-5 volt signals from your 8051 to ± 10 , for the terminal.

Below is a circuit based on the reference design. It sets up the chip correctly and pulls the signal and power pins out to a 20-pin header. If you mount the header on the bottom side of the board you can just plug this into your breadboard whenever needed.

Jameco Part #s

DE9P318	Male 9-pin connector .318 set back
DE9P590	Male 9-pin connector .590 set back
DE9P450	Male 9-pin connector .450 set back [not listed, but may exist]
79273	6-pin mod plugs
24811	MAX232CPE
93577	10 uF Caps
53479	Dual row 20-pin straight male header

Art Popp
via Internet

AST GLOBAL ELECTRONICS

24529 STATE HWY. 408, CAMBRIDGE SPRINGS, PA 16403
VOICE 814-398-8080 • 1-888-216-7159 • FAX 814-398-1176

VIEW COMPLETE LISTING AT:
<http://www.astglobal.com>

IF WE DON'T CARRY IT ... WE'LL FIND IT
QUICKLY ... AT REASONABLE PRICES.

B&K 3020, Sweep/Function Generator, 2MHz (Sine, Square, Triangle)	\$175
Dranetz 626, Universal Disturbance Analyzer, Frame only w/Power Supply & Communication Plug-in	\$375
EIP 545, Microwave Counter, 18GHz	\$650
ESI DP1311, Variable Resistor, 100K max 1K/Step	\$100
ESI RV726, Decade Voltage Divider	\$375
Fuke 332B, DC Voltage Standard	\$475
Fuke 335A, DC Voltage Standard	\$375
Fuke 382A, Voltage/Current Calibrator	\$525
Fuke 540B, Transfer Standard w/ASA-2 Voltage Plug-in	\$625
Fuke 721A, Lead Compensator	\$275
Fuke 760A, Meter Calibrator	\$450
Fuke 845AB, Null Detector/Micro Voltmeter 1uV-1000VDC	\$375
Fuke 845AR, Null Detector/Micro Voltmeter 1uV-1000VDC	\$375
Fuke 893A, AC/DC Differential Voltmeter 0 to 1100 Volts, AC/DC, .01%DC, .05%AC, 1uV Resolution (7-digit)	\$100
Fuke 3330B, Constant Current/Voltage Calibrator	\$475
Fuke 5100B, Multifunction Calibrator, Opt. 03/05	\$3,250
Fuke 5100B, Multifunction Calibrator	\$2,700
Fuke 5200A, Programmable AC Calibrator	\$1,250
Fuke 5215A, Precision Power Amp	\$950
Fuke 6011A, Synthesized Signal Generator, 10Hz-11MHz	\$550
Fuke 6060B, Synthesized Signal Generator 10KHz-1050MHz	\$1,800
Fuke 6070A, Synthesized RF Signal Generator 200KHz-520MHz	\$1,500
Fuke 8000A, DMM 3-1/2 Digit	\$75
Fuke 8050A, DMM 4-1/2 Digit w/Battery Pack	\$145
Fuke 8050A, DMM 4-1/2 Digit w/o Battery Pack	\$145
HP 6294A, Power Supply, 0-60V @ 1A (metered)	\$275
HP 8011A, Pulse Generator, 1Hz-20MHz	\$175
HP 8013B, Pulse Generator, 1Hz-50MHz	\$275
HP 8015A, Pulse Generator, 1Hz-50MHz 30V	\$425
HP 8091A, Rate Generator (1GHz) w/8092A Delay Generator (1GHz) w/8093A Output Amp w/15401A & 15400A	\$2,000
HP 8165A, Programmable Sig Source, 1mHz-50MHz	\$950
HP 8180A, Data Generator	\$425
HP 8410B, Network Analyzer Mainframe	\$275
HP 8414A, Polar Display	\$225
HP 8443A, Tracking Generator, 1KHz-110MHz	\$325
HP 8444A, Tracking Generator for 141T System, .5-1300MHz	\$325
HP 8445B, Auto Preselector, 1.8-18GHz	\$750
HP 8553B, RF Plug-in (for 140 Series Mainframes), 1KHz-110MHz	\$425
HP 8553L, RF Plug-in (for 140 Mainframes), use with 8552A, 1KHz-110MHz	\$125
HP 8601A, Sweeper Generator, 1-110MHz	\$425
HP 8614A, Signal Generator, 800-2400MHz, AM/FM Leveled	\$475
HP 8616A, Signal Generator UHF, 1.8-4.5GHz, 4-120dB, AM/FM	\$475
HP 86242D, RF Plug-in, 5.9-9.0GHz	\$350
HP 8640B, Signal Generator, 5-1050MHz, Opt. 002/001 or 003	\$1,800
HP 8640B, Signal Generator, 5-512MHz, Opt. 001 or 003	\$950
HP 8743A, Reflection Test Set, 2-12.4GHz	\$475
HP 8901A, Modulation Analyzer	\$1,000
HP 59303A, D/A Converter	\$175
HP 59501A, HP-IB Isolated D/A Converter	\$125
Hunttron Tracker 2000, w/410 Switcher (nice)	\$1,000
Keeco ATE15-50M, Power Supply, 0-15V @ 50A (metered)	\$650
Keeco ATE55-5M, Power Supply, 55V @ 5A	\$425
Keeco BVP100-4M, Bi-Polar Power Supply, 0-100V @ 4A (metered)	\$520
Keeco JQE 36-15MVPT, Power Supply, 0-36 @ 15A (metered)	\$275
Keeco JQE 36-3MVPT, Power Supply, 0-36 @ 3A (metered)	\$175
Krohn-Hite 3202R, Dual Channel Tunable Filter, 20Hz-2MHz, High Pass, Low Pass Band Reject	\$275
Polarad SPNH, Signal Generator, 20Hz-20KHz	\$450
Polarad SPNL, Signal Generator, 1Hz-600KHz	\$350
Racal Dana 9303, True RMS RF Level Meter	\$550
Rockland 1022F, Dual HiLo Filter	\$150
Rockland 5100, Synthesizer, DC-2MHz, .001 Hz Resolution	\$325
Sencore SC61, Scope (100MHz) w/New Probes, Dual Trace	\$750
Sencore SC61, Scope (100MHz) w/Probes, Dual Trace	\$500
Sencore SC3100, Waveform Analyzer (like new)	\$1,900
Sencore TVA92, TV Video Analyzer	\$1,100
Sorenson DCR-80-5A, Power Supply, 80V @ 5A (metered)	\$475
SRL 112B, PLO/PRF Synthesizer	\$125
Tek DC503, Plug-in Counter Universal, 100MHz	\$150
Tek DM501A, Plug-in DMM, 4-1/2 Digit	\$175
Tek DM502, Plug-in DMM, 4-1/2 Digit	\$150
Tek FG501, Plug-in Function Generator, .001Hz-1MHz	\$175
Tek FG504, Plug-in Function Generator, .001Hz-40MHz	\$450
Tek PG501, Plug-in Pulse Generator, 5Hz-50MHz	\$175
Tek PS501-1, Plug-in Power Supply	\$150
Tek PS503A, Plug-in Power Supply Triple	\$175
Tek OIG-502, Plug-in Optical Impulse Generator (unused)	\$950
Tek T922, Scope (15MHz), Dual Trace, nice	\$175
Tek TM503, Power Module, 3 Slot	\$125
Tek TM504, Power Module, 4 Slot	\$150
Tek TM506, Power Module, 6 Slot	\$200
Tek TWD120, Digitizer	\$675
Tek 7A16A, Plug-in (225MHz), Single Trace Amp	\$100
Tek 7A18, Plug-in (75MHz), Dual Trace Amp	\$75
Tek 7A19, Plug-in (600MHz), Single Trace Amp	\$150
Tek 7A26, Plug-in (200MHz), Dual Trace Amp	\$150
Tek 7B50A, Plug-in (150MHz), Time Base	\$100
Tek 7B53A, Plug-in (100MHz), Dual Time Base	\$125
Tek 7B70, Plug-in (300MHz), Time Base	\$150
Tek 7B80, Plug-in (400MHz), Delayed Time Base	\$150
Tek 7B92A, Plug-in (500MHz), Dual Time Base	\$200
Tek 7D11, Plug-in Digital Delay	\$175
Tek 7D13, Plug-in DMM 3-1/2 Digit	\$125
Tek 7D15, Plug-in Counter/Timer, DC-225MHz	\$225
Tek 7L18, 1.5-80GHz Spectrum Analyzer	\$1,700
Tek 7S11, Plug-in Sampling Unit	\$175
Tek 134, Current Probe Amp	\$100
Tek 453, Scope (60MHz), Dual Trace	\$175
Tek 465, Scope (100MHz), Dual Trace	\$425
Tek 465B, Scope (100MHz), Dual Trace	\$475
Tek 466, Scope (100MHz storage), Dual Trace	\$575
Tek 475, Scope (200MHz), Dual Trace	\$475
Tek 475A, Scope (250MHz), Dual Trace	\$625
Tek 475DM44, Scope (200MHz), Dual Trace w/DMM	\$575
Tek 485, Scope (350MHz), Dual Trace	\$850
Tek 520A, NTSC Vectorscope	\$575
Tek 2213, Scope (60MHz), Dual Trace	\$375
Tek 2215, Scope (60MHz) Dual Trace	\$450
Tek 2235, Scope (100MHz) Dual Trace	\$650
Tek 2236, Scope (100MHz) w/Counter/Timer/DMM	\$800
Tek 2336, Scope (100MHz) Dual Trace	\$650
Tek 2445, Scope (150MHz), 4-Channel Cursor Readout	\$1,700
Tek 2465, Scope (300MHz), 4-Channel Cursor Readout	\$2,400
Tek 7104, Scope (1GHz), Dual Trace	\$1,750
Tek 7603, Scope Mainframe (100MHz)	\$200
Tek 7704A, Scope Mainframe (250MHz)	\$200
Tek 7854, Scope (400MHz), Dual Beam w/Waveform Calculator	\$625
Tek 7904, Scope Mainframe (500MHz)	\$275
Wavetek 145, Pulse/Function Generator, .0001-20MHz	\$350
Wavetek 185, Lin Log Sweep Generator, .0001Hz-5MHz	\$425
Wavetek 288, Synthesized Function Generator, 20Hz-20MHz (unused)	\$950
Wavetek 3000, Signal Generator, 1-520MHz	\$525
Wavetek FG3B, Sweep/Function Generator 2Hz-100KHz (unused)	\$375

TURN IDLE TEST EQUIPMENT
— INTO CASH —
CALL OR FAX FOR QUOTATION

Fuke 8520A, DMM 5-1/2 Digit	\$325
Fuke 8600A, DMM 4-1/2 Digit w/o Battery Pack	\$125
Fuke 8800A, DMM 5-1/2 Digit	\$175
Fuke 9010A, Micro System Troubleshooter	\$375
Fuke 93, Scopemeter (unused)	\$950
Gould K105-0, Logic Analyzer w/4 Probe Pods	\$500
HP 141T, Spectrum Analyzer Mainframe	\$475
HP 141T, Spectrum Analyzer w/8552A/8553B, 1KHz-110MHz	\$1,000
HP 141T, Spectrum Analyzer w/8552B/8553B, 1KHz-110MHz	\$1,200
HP 141T, Spectrum Analyzer w/8552B/8556A, 20Hz-300KHz	\$1,100
HP 141T, Spectrum Analyzer w/8552B/8554B, 1KHz-1.2GHz	\$1,700
HP 141T, Spectrum Analyzer w/8552B/8555A, 10MHz-18GHz	\$1,900
HP 180TR, Scope Mainframe	\$250
HP 204B, Oscillator, 5Hz-1.2MHz, 5VRMS	\$100
HP 204C, Oscillator, 5Hz-1.2MHz, 5VRMS	\$125
HP 214A, Pulse Generator, .08V-100V	\$200
HP 334A, Distortion Analyzer	\$275
HP 350D, Attenuator	\$75
HP 400EL, AC Voltmeter, 10Hz-10MHz	\$150
HP 400FL, RMS Voltmeter, 20Hz-4MHz, 100uV-300V	\$175
HP 403B, AC Voltmeter Battery Operated, 5Hz-2MHz, 1mV-300V	\$100
HP 415E, SWR Meter	\$100
HP 427A, Multi-function Meter (AC, DC & Resistance 10Hz-1MHz)	\$100
HP 432A, Power Meter w/Cable/8478, .01-18GHz Sensor	\$350
HP 432A, Power Meter w/o Cable/Sensor	\$150
HP 435A, Power Meter w/o Cable/Sensor	\$175
HP 651B, Test Oscillator, 10Hz-10MHz	\$150
HP 652B, Test Oscillator, 10Hz-10MHz	\$150
HP 654A, Oscillator, 10Hz-10MHz, 90dB Attenuator	\$225
HP 1630D, Logic Analyzer w/Probes	\$550
HP 1980B, Scope Measurement System w/1965A Gated Universal Timer (like new)	\$550
HP 3312A, Function Generator, 1Hz-13MHz	\$490
HP 3325A, Programmable Frequency Synthesizer 1Hz-32MHz	\$1,100
HP 3330B, Automatic Synthesizer, 20Hz-13MHz	\$325
HP 3400A, True RMS Voltmeter, 10Hz-10MHz, 1mV-300V	\$175
HP 3403C, True RMS Meter, AC/DC/0dB 100MHz	\$275
HP 3406A, RF Voltmeter, 50uV-3V, 1.2GHz	\$250
HP 3455A, DMM 5-1/2 Digit	\$250
HP 3456A, DMM 6-1/2 Digit	\$525
HP 3466A, DMM 4-1/2 Digit, AC/Battery, 5 Function	\$225
HP 3575A, Digital Phase Gain Meter	\$650
HP 3580A, Spectrum Analyzer, 5Hz-50KHz, LED Readout	\$850
HP 3581A, Wave Analyzer, 15Hz-50KHz	\$350
HP 3770A, Amplitude/Delay Distortion Analyzer	\$425
HP 3779B, Primary MPX Analyzer	\$625
HP 3781B, Pattern Generator	\$300
HP 4332A, LCR Meter	\$450
HP 5316A, Counter, 100MHz, HP-IB	\$475
HP 5328A, Counter, 100MHz w/DVM/Opt. 021	\$250
HP 5328A, Counter, 500MHz	\$350
HP 5334A, Counter, 100MHz, Opt. 010 Oven	\$600
HP 5340A, Counter, 18GHz (nixie)	\$700
HP 5345, Counter, 500MHz	\$450
HP 5345A, Counter, 500MHz, HP-IB	\$650
HP 58307A, VHF Switch	\$125
HP 6104A, Precision Power Supply, 20V @ 3A, 20-40V @ 1A (metered)	\$175
HP 6112A, Power Supply, 40V @ .5A (metered)	\$175
HP 6116A, Power Supply, 0-100V @ 200mA (metered)	\$125
HP 6202B, Power Supply, 40V @ .75A (metered)	\$175
HP 6203B, Power Supply, 7.5V @ 3A (metered)	\$175
HP 6205B, Power Supply (dual), 0-40V @ .3A, 0-20V @ .8A (metered)	\$225
HP 6206B, Power Supply, 0-60V @ 1A (metered)	\$250
HP 6253A, Power Supply (dual), 0-25V @ 3A (metered)	\$225
HP 6260B, Power Supply, 10V @ 100A (metered)	\$400
HP 6265B, Power Supply, 40V @ 3A (metered)	\$250
HP 6266A, Power Supply, 40V @ 6A (metered)	\$250
HP 6289A, Power Supply, 0-40V @ 1.5A (metered)	\$225



• 60-DAY WARRANTY
• 10-DAY RIGHT OF RETURN
• SATISFACTION GUARANTEED

How many shopping days til Christmas?

If you're looking for that perfect gift for the hard-to-please electronics enthusiast, why not surprise them with a gift subscription to Nuts & Volts Magazine!?

Order
today!

Nuts & Volts Magazine
430 Princeland Court, Corona, CA 91719
800-783-4624 • 909-371-3052 FAX
<http://www.nutsvolts.com>

Tiny FBasic Computer



(Shown 85% Actual Size - 40 pin DIP)

The TICkit 62 module is like a Parallax Basic Stamp II, but has 4 times the program space installed (expandable to 64K). It also has 4 times the variable space (96 bytes), and uses a modern structured language similar to BASIC only more powerful.

- Only tool you need is a PC
- Inexpensive \$45/module, \$16/IC
- Development Kit only \$45
- Huge library of I/O function
- Structured FBasic Language
- Easy to learn and use
- Powerful enough for large projects

ASK ABOUT OUR STAMP COMPATIBLE PERIPHERAL COMPONENTS

VersaTech
Electronics

PHONE: (303) 828-9156, FAX: (303) 828-9316
e-mail: versatech@csn.net

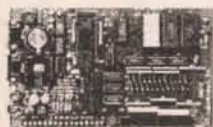
Web: //www.csn.net/versatech

11170 Flatiron Drive, Lafayette, CO 80026

Basic Stamp is a registered trademark of Parallax, Inc.

IndustroLogic™

Fast, friendly project development!



**SBC-1 80C51
Single Board
Computer**
\$179

Menu based monitor and BASIC in ROM. 50 I/O, A/D, RTC, serial, I/O rack interface, up&download to EEPROM. Includes software.



**SMD-12 Stored
Message Display**
\$179

Display & enter messages with switch closure or serial port. 12 messages of up 32 characters. 6"W x 3"H x 6"D Steel case.



**SIO-1000 RS-232
Data Acquisition
Interface Board**
\$179

8 TTL in, 8 TTL out, dual 12 bit A/D & D/A channels. counter in, frequency out, WINDOWS/DOS software, cable, case & supply. 4.25" x 6.5" x 1.5" high. 12 oz.

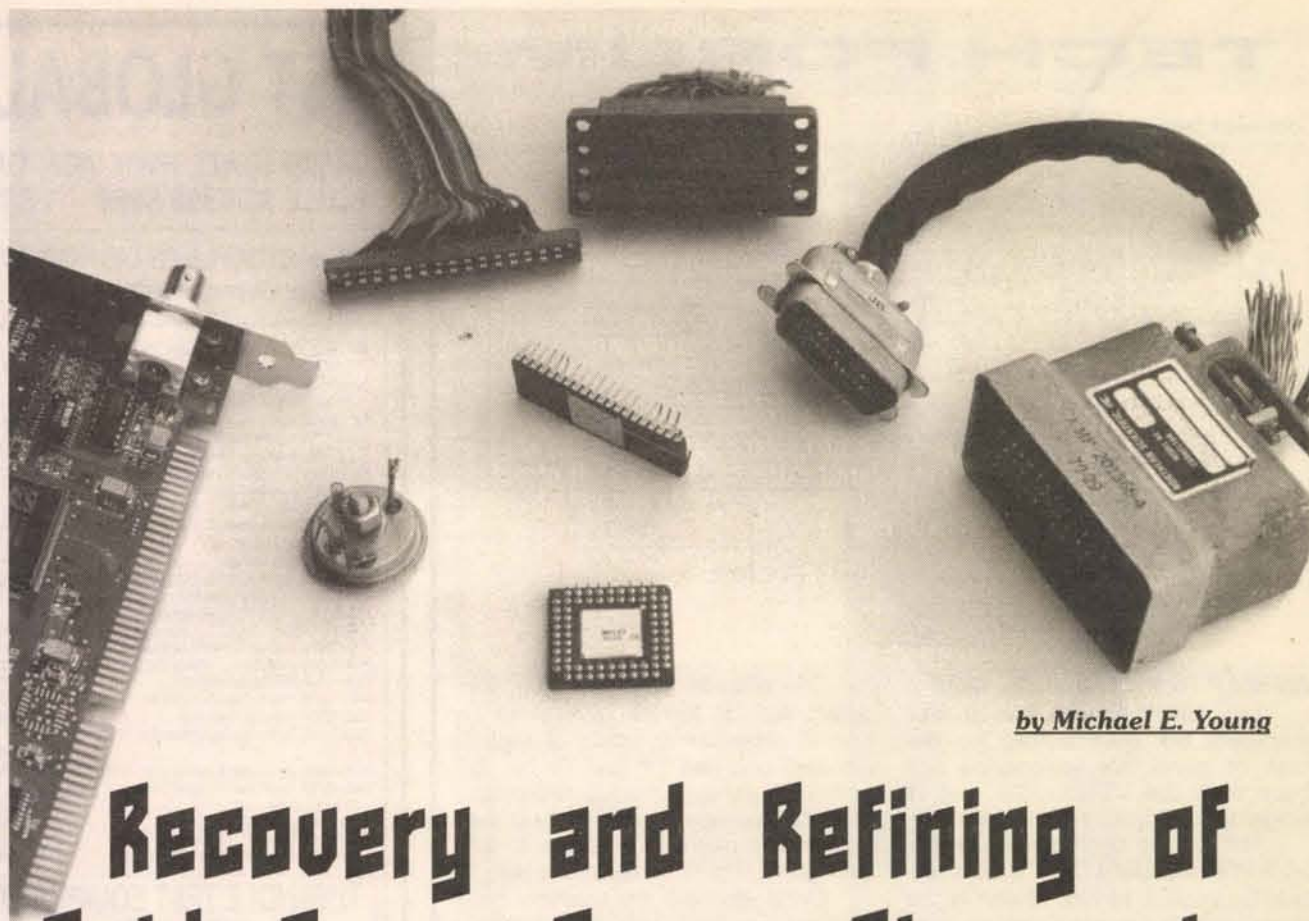
Industrologic, Inc.
3201 Highgate Lane
St. Charles, MO 63301

(314) 707-8818
9AM-5PM Central

technical info on the Web!

industrologic.com

34 on Reader Service Card.



by Michael E. Young

Recovery and Refining of Gold From Scrap Electronics

Introduction

Probably the most lucrative area in recycling today is in the recovery of precious metals. In this article, we will discuss the recovery of gold from scrap electronics and demonstrate a method you can use to recover gold on a small scale in your own backyard.

Finding gold-containing components is really not very hard. The basic rule you should remember is that if it looks like gold, it is gold. Don't become overly concerned with how much gold is contained in components you can't see. There are plenty of sources of visible gold available. This article describes just one method (there are others) to recover gold and is written on a scale intended for the hobbyist.

The procedure given in this article requires the use of some chemicals that are very dangerous and will require some care and preparation on your part. **So read the section on safety carefully and make sure you have all the safety equipment you need.** If you feel uncomfortable working with acids, it might be a good idea to enlist the aid of someone such as a local high school chemistry teacher to help you.

Safety

Acids can cause severe burns on skin, eyes, nose, and throat. Avoid inhalation, ingestion, and skin contact. Be familiar with the chemicals used in this procedure and use proper safety precautions. Obtain a copy of the *Material Safety Data Sheet* for all chemicals and make sure you read it and the container labels carefully.

Always wear safety goggles, laboratory apron, and chemical resistant gloves. Wear eye protection that will protect from splashes and impact. If any chemical gets in the eyes, wash

them continuously with flowing water and seek immediate medical attention.

Have safety shower, eyewash, fire extinguisher, telephone and emergency phone numbers handy.

Do not inhale fumes from chemicals. Perform all experiments under an exhaust hood or outside.

Do not eat, drink, or smoke while handling chemicals.

If any chemical comes in contact with the skin, wash it immediately and summon medical assistance. Refer to the *Material Safety Data Sheet* for more information.

Read the chemical container warning label before removing a chemical from its container.

Never work alone!

Some Basic Facts About Gold

Gold is found in almost every piece of electronics manufactured today. It is used in semiconductor packages, connectors, printed circuits, telephones, relays, communications equipment, contacts, and switches to name only a few. Gold is used in electronics because of its properties. It has excellent conductivity, is resistant to corrosion and oxidation, and is very malleable. Gold can be fashioned into very small wires and thin sheets. An ounce of gold can be made into a sheet covering 250 square feet and only four-millionths of an inch thick or drawn into a wire 50 miles long.

Gold occurs in seawater in the amount of 0.1 to 2.0 milligrams (mg) per ton and the earth's crust is estimated to have an average gold content of about 0.0034 gram per metric ton.

Gold is measured in

"troy" weight. There are 31.1 grams of gold in a troy ounce. Since gold is usually alloyed with other metals, a measurement called the "karat" is used to express the amount of gold with 24 karat being pure gold. For example, 14 karat gold contains 14 parts gold and 10 parts other metals. Fineness refers to the weight proportion of pure gold in an alloy expressed in parts per thousand.

Gold resists attack by most chemicals including nitric acid, sulfuric acid, and hydrochloric acid. However, it can be dissolved in aqua regia. Aqua regia is a solution of one part concentrated nitric acid and three parts concentrated hydrochloric acid. It means "royal water."

Sources of Gold

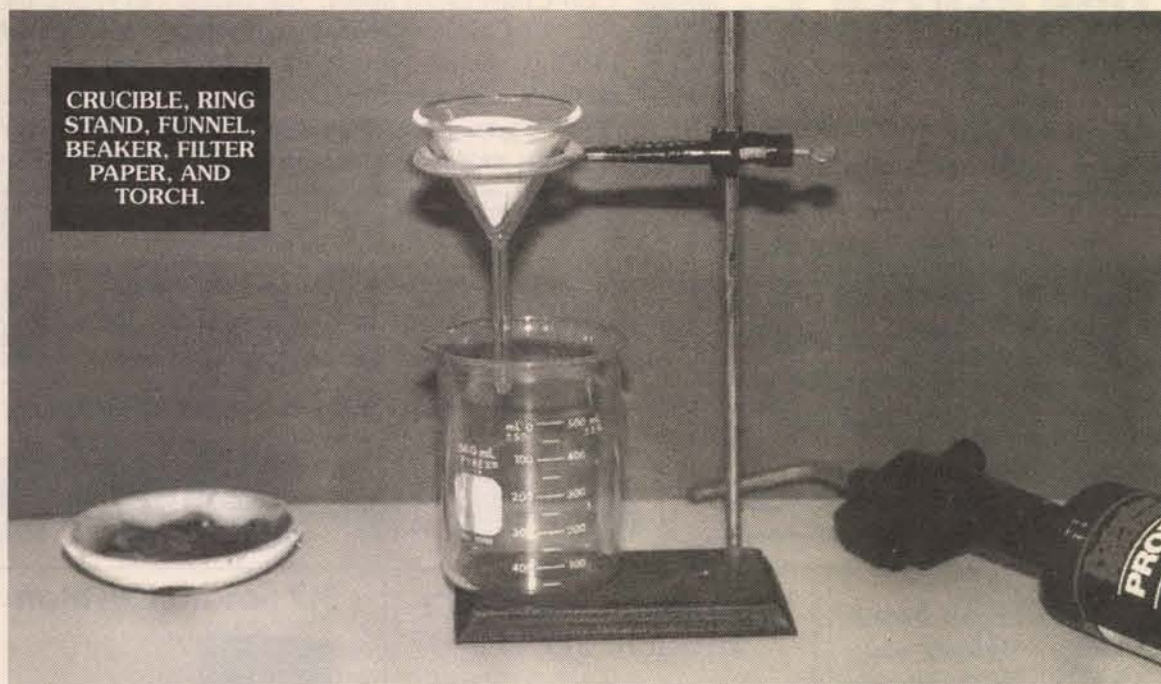
The first step is to obtain some gold containing components. This can be some old military connectors, circuit card edges, gold plated terminals, or contacts. Remember if it looks like gold then it's worth getting. Also, the older the electronics are, the thicker the gold is likely to be. This is because gold was cheaper then and the methods used to deposit gold were not as good as they are now. So older material is better, but it's not necessary.

Some moderately-sized operations

- Hydrochloric Acid HCl (reagent)
- Nitric Acid HNO₃ (reagent)
- Dibutyl Carbitol (diethylene glycol dibutyl ether)
- Potassium Oxalate K₂C₂O₄
- Distilled Water
- Filter Paper
- One 500ml Beaker and One 600ml Beaker
- Glass Funnel
- Stainless Steel Forceps or Long Tweezers
- Crucible
- Propane Torch
- Ring Stand

Table 1: Supplies and Equipment

CRUCIBLE, RING
STAND, FUNNEL,
BEAKER, FILTER
PAPER, AND
TORCH.



have grinders to grind up entire circuit boards and then process the grindings. Gold-plated components are recommended here to make it easy to see that the process is working.

Physically strip down the electronics and remove only the components that contain gold. In a connector, this means removing the gold-plated contacts; on a circuit card this means cutting off the edge connector. Reduce the components down to just the parts that have gold on them. For the purposes of this article, each piece should all be small enough to fit in a small laboratory beaker. To complete the process described below, you will need about enough gold-plated parts to fill a quart jar.

Required Materials

Table I is a list of the chemicals and chemical supplies you will need. Note that this list does not include the safety equipment you need that was mentioned earlier. Some sources to obtain these supplies are listed in Table II. A local chemical supply company, as well as the chemical supply store at a nearby university, are good places to start. Also, the acids must be laboratory grade. Diluted acids will probably give poor results or not work at all.

Procedure

Once you have all the supplies, chemicals, and some gold-bearing components ready, you can begin. It is important that you read the whole procedure as it is written here before you begin. Make sure you understand everything and that you have everything you need. Also make sure you are familiar with the section on safety. The following is the step-by-step procedure to remove the gold from the components that you collected earlier.

Prepare a solution by mixing 50ml of nitric acid with 150ml of hydrochloric acid in a 500ml beaker. This

liquid is yellow and produces poisonous, suffocating fumes. The solution of one part nitric acid and three parts hydrochloric acid is called aqua regia.

Use the stainless steel forceps to place some of the gold-bearing components in the solution. The gold will immediately begin to be stripped and dissolved. Observe the components carefully and remove them as soon as it appears that all the gold has been removed. Discard these and place some fresh components in the solution. Repeat this step until you run out of components or the aqua regia grows weak. You will know this because the reaction will slow and it will take longer to see the gold disappear.

Add about 100ml of distilled water to the solution from step 2 and stir gently. To this, add about 30ml of dibutyl carbitol and continue to stir gently. You should notice a brown extract forming in the beaker that will settle to the bottom. Allow the solution to sit until the brown extract settles to the bottom of the beaker. Carefully pour off the liquid into another beaker being careful to leave the extract behind in the first beaker.

To the beaker containing the brown extract, add distilled water in volume of about the same as the extract. Add about 2-3 grams of potassium oxalate and stir. It is desirable to stir this solution for a few hours, but good results can be had with less.

Remove the extract from the solution by pouring it into a glass funnel lined with filter paper. Make sure the solution is diluted with distilled water enough so that the acid does not melt the filter paper. Rinse with water until all of the extract is washed into the filter paper.

Place the filter paper in the crucible and allow to dry. Then take a

propane or oxygen/propane torch and gently heat the filter paper and extract. The filter paper will burn away. Continue to slowly heat the brown powder until it begins to vaporize. As the powder vaporizes you will see a small pellet of gold begin to form in the bottom of the crucible. Be careful not to over heat the gold causing it to boil away. Take care that the force of the torch flame doesn't blow the extract or the gold out of the crucible. Keep the torch on the lowest flame necessary.

Summary

It is not unusual to obtain one or two grams of relatively pure gold on this scale. The gold obtained is typically of good purity with low concentrations of alloyed metals such as copper. Of course, more gold can be obtained per run by increasing the scale of this process.

Any number of variables can affect the outcome. One of these factors is temperature. You might want to experiment with warming the solution during the final stirring (step 4). Of course, the quality of the chemicals and the quality of the gold components will make a difference. While this particular process is useful for the hobbyist, there are several other processes that may be more appropriate for larger scale operations. These mainly vary in the method used to extract the gold from the aqua regia solution. This is a good area to experiment in and to do research.

Although the emphasis of this article is the recovery of gold from scrap electronics, the procedure for recovering gold from other sources such as jewelry, dental work, trophies, or eyeglass frames is essentially the same. Any gold-plated components can be used. NV

Michael Young can be contacted at myoung@mail.ala.net or P.O. Box 145, Newville, AL 36353.

Fluka Chemical
980 South 2nd Street
Ronkonkoma, NY 11779
1-800-358-5287

Fisher Scientific
711 Forbes Avenue
Pittsburgh, PA 15219-4785
1-800-766-7000

Thomas Scientific
P.O. Box 99
Swedesboro, NJ 08085-0099
1-800-345-2100

Hagenow Laboratories Inc.
1302 Washington Street
Manitowoc, WI 54220

Sigma Chemical Company
P.O. Box 14508
St. Louis, MO 63178
1-800-325-3010

Aldrich Chemical Company
940 West Saint Paul Avenue
Milwaukee, WI 53233
1-800-558-9160

Table II: Sources of Supplies

Table III: Units, Conversions, and Properties

31.1 grams (g) = 1 troy ounce
10³ grams (g) = 1 kilogram (kg)
453.59 grams (g) = 1 pound (lb)
1 milliliter (ml) = 1 cubic centimeter (cm³)
1 milliliter (ml) = 10⁻³ liters (l)
Melting point of gold 1064.4° C or 1947° F
Boiling point of gold 2857° C or 5174.6° F

Great Books for Hobbyists, Students, Engineers . . .

Simple, Low-Cost Electronics Projects

by Fred Blechman

Learn electronics with Fred Blechman's exciting new book. Begin with simple designs and progress to more sophisticated projects. Each project comes with a complete discussion of circuit theory and parts list, as well as information on troubleshooting and testing. Build voltmeters and multimeters, inductance and semiconductor testers, variable frequency audio oscillators, a photoelectric counter, and much more!

1-878707-46-9/224 pages/\$19.95



Controlling the World with Your PC

by Paul Bergsman

PC Disk Included! Connect your computer to the real world and make it do useful work like controlling stepper motors, turning appliances on and off, or monitoring fluid levels. PC disk contains software files in ready-to-use form.

1-878707-15-9/208 pages/\$35.00



The Forrest Mims Engineer's Notebook

by Forrest Mims III

This revised edition of Forrest's classic book includes hundreds of useful circuits built from integrated circuits and other parts available from convenient sources.

1-878707-03-5/156 pages/\$19.95



The Integrated Circuit Hobbyist's Handbook

by Thomas R. Powers

Covers the major types of integrated circuit devices—linear, TTL, and CMOS—and provides complete details and theory about their operation. Contains lots of useful application circuits—an essential reference for every hobbyist.

1-878707-12-4/256 pages/\$19.95



Order on the Web!
For these and other great books on electronics, visit:
www.LLH-Publishing.com

or
call 1-800-247-6553 to use a major credit card, or send check or money order to:

LLH
Technology Publishing
3578 Old Rail Road
Eagle Rock, VA 24085

COMPUTER CIRCULATION CENTER, Inc.

dba: Alltech Electronics

2618 Temple Heights Drive.

Oceanside, CA 92056

Phone Order Hours 9AM - 5:30PM Mon-Fri

Phone Orders

760/724-2404

\$25 -Min. Order -

9350 Clairemont Mesa, San Diego - 619/573-0411

1401 El Camino Real, Oceanside - 760/721-0093

1300 E. Edinger, Santa Ana - 714/543-5011

2018 W. Lomita BLVD, Lomita - 310/539-2260

We buy surplus & excess computer inventory as well as scrap electronics related inventory.

Mitusubishi DJ-1000

Digital Camera

Pocket Size

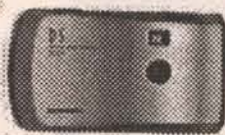
Holds up to 15 images

320 x 240 or 504 x 378

PCMCIA Required for image downloading.

Windows 3.1/95 Compatible

See the web for more details



\$79

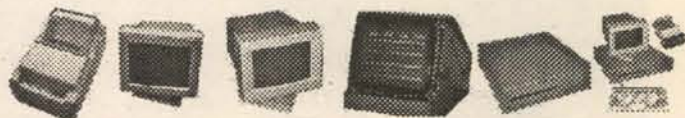
Be sure to check our Web Site for more information on these and other products!

www.allelec.com

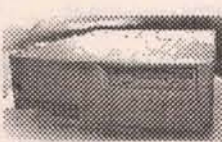
Save on your Point of Sale systems with these refurbished and new components.

9" Monochrome VGA NEC **NEW** 640 x 480	\$79.00
10" SVGA COLOR View Magic .26 dp Refurb (upto 1024 x 768)	\$139.00
10" SVGA Color (Open Frame - Build a custom enclosure)	\$119.00
Fujitsu Cash Drawer NEW w/till. 24VDC Trigger for drawer	\$79.00
Cash Drawer - Epson Printer - 9" Mono VGA	\$199.00
Cash Drawer - Epson Printer - 10" Color SVGA .26 dp	\$299.00
Compact footprint 83 Key keyboard - PS/2 Type	\$14.95
Epson TM300PD Parallel Receipt Printer (2 Color) Refurb	\$89.99

Point of Sale Hardware



NEC Mini 486



Need a Linux Box?

\$29.00

Mini footprint
3.5" x 11.5 x 13
486 SX 25 CPU
4MB On board
2 ISA Slots
IDE, FD, 2
COM, 1 LPT &
512K VGA
UPGRADABLE
to DX2/66



8 for \$20

1.75" Dia. Lt Wt Wheel

Light to lt-medium duty usage.
360 degree swivel with locking brake. Smooth rolling action.

Intergraph 4MB PCI Intense 3D 100

\$35.00

Rendition V1000e



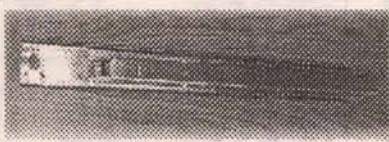
3D Accelerated Video Card for Windows 95/NT
See Web for more details

3D Sound Cushion



\$39.95

Bring Life to your games and music experience. See the web for more info.



6 pair for \$29.00

Extends to 2' past. Two slide telescopic extension

Ball Bearing Drawer Slide

10" Color SVGA!

Up to 1024 x 768 pixels
110V AC operation.

Refurb: \$139.00

ViewMagic



\$9.95

Small DC Motor w/gear box & Wheel

Robotic Attachments? Arms, etc? With rubber o-ring on 5" dia. disc.

External SCSI Cases

\$29.00 & Up



5.25" Closed HH \$29.
5.25" Open HH \$35.
5.25" Open FH \$45.
3.5" Open for Zip, Syquest, etc... \$29.
3.5" Lunchbox \$19.
All cases have two 50 pin centronics connectors.

Small 105V 40 RPM Motor. 2.7W

\$9.95

Motor with spindle. Items can be press fit. Shaft has a through hole with a rod stuck in it.



Motorola Flip Phone Data Adapter



\$39.00

RJ-11 (Dial Tone) Generator and Ring Generator. Use any standard land line device with your cell phone. Modem, credit card terminal, answering machine...

Large AC Motor. Use for robotic drive or ?? Has 5" disc attached with a rubber O-Ring.

\$9.95

Reversible 110V AC Motor with brake



\$69.00

24 pcs

Used 3" Dia. Wheels

360 degree rotatable. Ball Bearing for durability. These were from heavy duty mobile storage units.

CPUs

486SX 25/33	\$3.00	\$5.00
486SX2-66	\$8.00	\$8.00
486DX25/33	\$5.00	\$8.00
486DX2-50/2-66	\$14.00	\$19.00
486DX4-100	\$39.00	\$39.00
Pentium 75/90	\$39.00	\$49.00
Pentium 100 / 133	\$59.00	\$69.00
Pentium 166	\$79.00	\$79.00

Upgrade Your System



EPROMs

2716 /2732	\$1.25
2764 /27128	\$1.25
27256 /27512	\$1.50
1Meg	\$2.50
2 Meg	\$2.50

RAM Chips

4Meg x 9-80	\$15.00
1x32-70	\$9.00
2x32-70	\$19.00
4x32-70	\$35.00
1 meg x9-10	\$2.00
1 meg x9-80	\$3.00
1 meg x9-70	\$4.00

IDE Hard Drives

420 Meg	\$49.00
320 Meg	\$39.00
270 Meg	\$29.00
120 Meg	\$20.00
80 Meg	\$15.00
40 Meg	\$10.00



PC Oldies but Goodies

EGA/CGA Card -or- ISA Super I/O	\$14.95
2 Meg AT Memory Card - or - Parallel/Mono Card	\$9.00
Floppy Controller -or- Serial / Parallel Card	\$6.95
VLB 1 Meg VGA Card - or - 386 Motherboard w/2 Meg	\$19.95
16 Bit (ISA) VGA w 256/512/1 Meg	\$9.00 / \$12.00 / \$14.95
VLB Super I/O	\$12.95
8 Bit VGA Card - or - XT Motherboard w/640K	\$9.95

See Our Website for more details on these industrial surplus items.

Robot Competition? Feeling creative? Build something!

CD ROM & Sound Cards

4x IDE Internal	\$19.00
8x IDE Internal	\$29.00
24x IDE Internal with Yamaha Sound Card (ISA)	\$49.00
4x SCSI Internal	\$25.00
4x SCSI External	\$49.00
Universal Audio Cable (CD ROM to Soundcard)	\$4.95

HTTP://WWW.ALLELEC.COM

VISIT OUR WEB PAGE DAILY FOR SPECIALS & MORE INFO. ON THESE ITEMS

CA Residents please add 7.25% Sales tax. * Minimum shipping & handling charges \$8.50. * Warranty: Used/Refurbished products have a 90 day warranty. * ALL Returns must have an RMA # call before shipping back to us. * No Returns without an invoice. Shipping & Handling charges are non-refundable. * 20% Restocking charge, applies to products purchased in error & incompatibility problems. School & University Purchase Orders accepted, others on AOC only. * Prices and availability subject to change at anytime without any notification whatsoever.

AMATEUR ROBOTICS

NOTEBOOK

by Robert Nansel

Last time, I showed how to build a SIMMStick compatible with the Parallax BS-2. In the coming year, I intend to describe more projects using PBASIC controllers (such as the BS1-IC and the BS2-IC), but for the next few months, I want to shift into a different SIMMStick groove, one that will give at least a big price/performance boost over Stamps and offer much more flexibility.

There's a price to be paid for all these benefits, of course, and that price is learning to program in machine language — PIC assembly language in particular. The learning curve can be steep, but once you've done it, the results will more than justify the effort required.

In the process, I'll be showing you lots of tools, techniques, and resources that will ease the transition from PBASIC Stamps to assembly language Screamer. This month, I've also got tidbits on a better way to bend wire and where to look for technological inspiration.

PICs, Stamps, and Ants

So far, all of the Breadbot projects I've presented in this column have used controllers programmed in either PBASIC I or PBASIC II. This has been convenient from the standpoint of just getting something up and running with a minimum of time, hassle, and cash. If you build more than one Breadbot, though, the cost of the PBASIC controllers, whether from Parallax or homebrewed with a SIMMStick, will mount up.

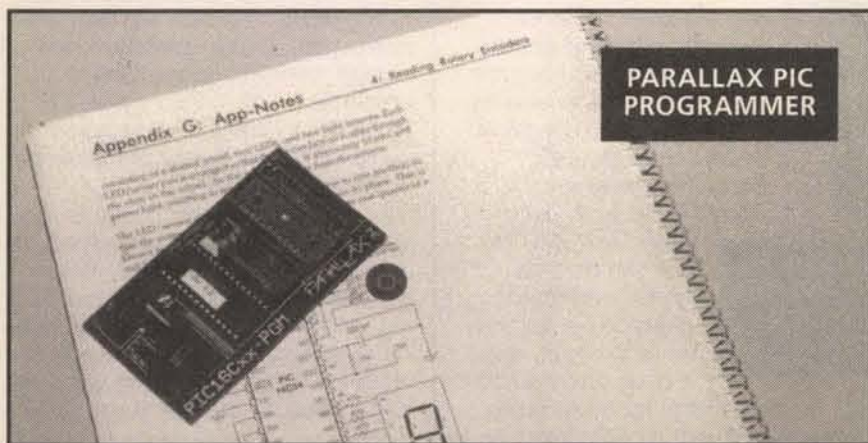
The BS2 SIMMStick from last time costs under \$40.00 US, not much cheaper than the Parallax BS2-IC (\$49.00 US). I could shave three, maybe four dollars off by soldering the chips in instead of using IC sockets, by using a ceramic resonator instead of a crystal, and by leaving out the voltage regulator (which isn't being used in Breadbot at present). If I were building just a couple Breadbots, I might well go this route if I wanted to stay with PBASIC as my programming environment.

But what if I want to build a

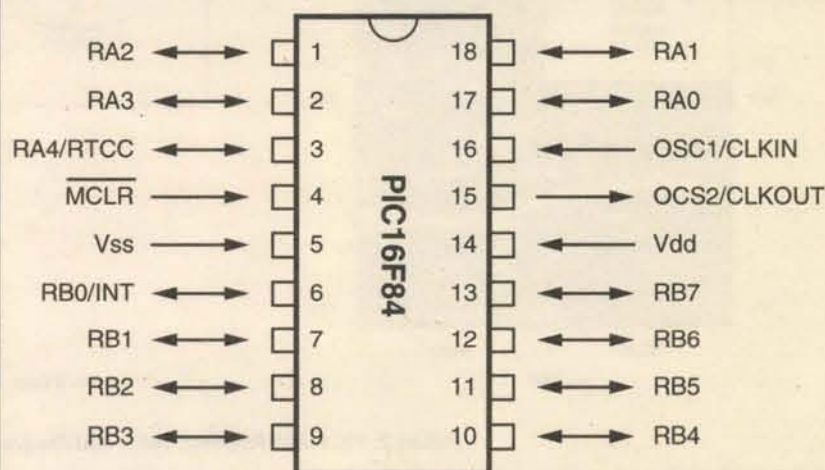
dozen Breadbots, say for a robot ant colony? The cost of a dozen BS-2 SIMMStick brains alone would be about \$430.00 US, and it's likely that all the extra sensors and inter-ant communications needed would

make the BS2 choke. At this point, I have to ask myself if there is a better way.

The most expensive part of the BS2 SIMMStick is Parallax's PBASIC II chip, which is really just a PIC16C57



PARALLAX PIC PROGRAMMER



Pin	Function
Vdd	Power supply 4.0 - 6.0 volts
Vss	Ground
RA0 - RA4	I/O Port A
RB0 - RB7	I/O Port B
INT	External interrupt input
RTCC	Real-time clock/counter input
MCLR	Master clear (reset)
OSC1/CLKIN	Oscillator input
OSC2/CLKOUT	Oscillator output (OSC/4)

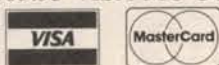
Figure 1: PIC16F84 pin-out

UNDETECTABLE PHONE TAP

- ☐ SOPHISTICATED ULTRA HIGH IMPEDANCE CIRCUITRY AS USED BY CIA AND KGB
- ☐ NOT DETECTABLE BY EVEN THE MOST ADVANCED TAP SWEEPING EQUIPMENT
- ☐ MONITOR CONVERSATIONS, FAXES AND DATA WITHOUT FEAR OF DETECTION
- ☐ PLUG INTO ANY TELEPHONE LINE WITH NO CLICK, HUM, NOISE OR VOLTAGE CHANGE
- ☐ UNIVERSAL DESIGN ALLOWS MONITORING WITH HEADPHONES, TELEPHONE OR TAPE RECORDER
- ☐ VOICE ACTIVATED TAPE RECORDER CONTROL
- ☐ DISGUISED AS "TELEPHONE LINE TESTER"
- ☐ COMPACT SIZE - BATTERY POWERED



\$109.95 VISA MC COD



(203) 485-0310

Ar² Communications Products

Box 1242 Burlington CT 06013

Write in 45 on Reader Service Card.

LASERS & ACCESSORIES

HELIUM NEON LASERS

- ☒ Complete Systems
- ☒ Plasma Tubes
- ☒ Power Supplies

ACCESSORIES

- ☒ Optics
- ☒ Electro-Optics
- ☒ IR Viewers
- ☒ Books & More



DIODE LASERS

- ☒ Visible / IR
- ☒ Complete Modules
- ☒ Collimating Optics
- ☒ Drive Circuits

FREE CATALOG

WEB SITE:

www.mi-lasers.com

MEREDITH INSTRUMENTS

Phone: 602-934-9387 • Fax: 602-934-9482

Write in 44 on Reader Service Card.

Nuts & Volts Magazine/December 1998 85

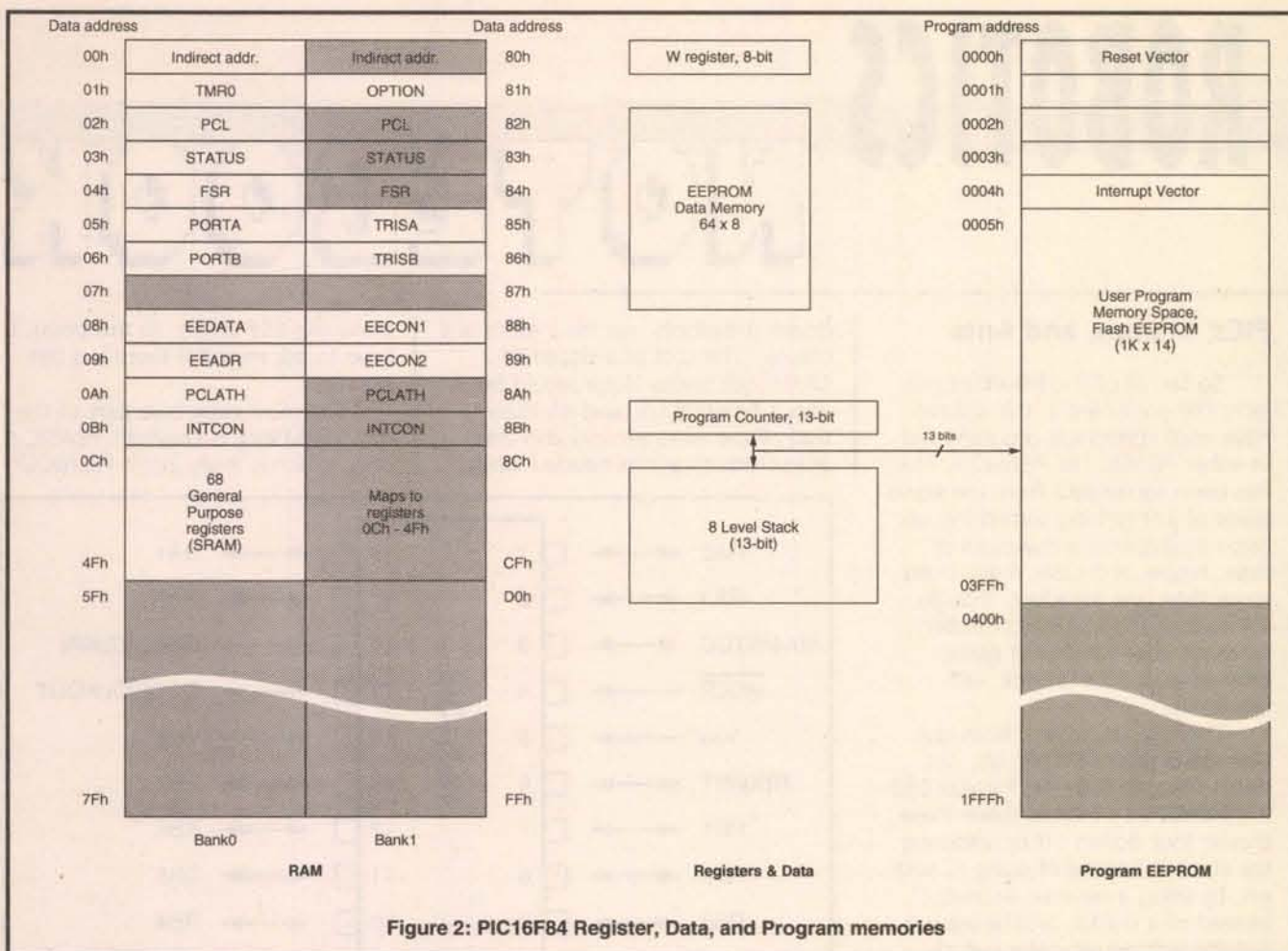
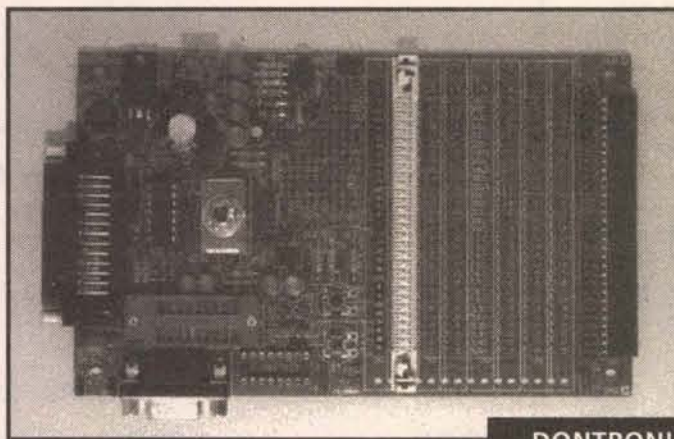


Figure 2: PIC16F84 Register, Data, and Program memories

programmed with Parallax's proprietary firmware.

The PIC16C57 currently cost less than \$6.00 US in a quantity of one for the "OTP" version, less than a quarter the price of the PBASIC II chip; if I could use a plain vanilla PIC, the cost of each Breadbot controller would be cut in half.

The problem with this rosy picture, though, is "OTP." That stands for one-time-programmable; great for production, but not for experimentation. There is a UV-erasable EPROM version of the PIC16C57, but it costs \$11.00 US. This is still cheaper than the PBASIC II, but I don't want to deal with the hassle of UV erasure. In-circuit reprogrammability is one of the big advantages of the BASIC



**DONTRONICS
DT001 SIMMstick
DEVELOPMENT
SYSTEM**

Stamps, and I'm loathe to let it go.

Luckily, Microchip has an EEPROM PIC available, the PIC16F84.

Flash to the Rescue

The PIC16F84 is a member of

Microchip's family of 14-bit core microcontrollers (the PIC16C57 is part of their older 12-bit family). It comes in a plastic package with 18 pins, of which 13 are I/O lines. It has 68 eight-bit words of directly addressed general-purpose R/W data memory and 64 eight-bit words of indirectly addressed data EEPROM. The program is stored in 1K by 14-bit

Flash EEPROM. The F84 can thus be erased and reprogrammed in seconds while in-circuit, and it costs under \$7.00

US, making it ideal for robot prototype development (see Figures 1 and 2).

The 14-bit core PICs can't all compete with a Motorola 68HC11 in

terms of on-chip RAM and EPROM, and they have no expansion bus so you can't add more RAM or ROM externally. They excel, though, where you need something small and fast, just enough computing horsepower to do the job. And cheap.

Even a low-end chip like the 68HC11A1 costs twice as much as a PIC16F84 and, unlike the Motorola chip, when you are satisfied with your code on an F84, you can easily port it to another 14-bit core PIC, such as the PIC16C711. The PIC16C711 comes in a pin-compatible OTP package functionally identical to the F84, only it has four optional A/D inputs, and it's two times faster and costs a couple dollars less than the F84.

For simple applications, you could even go all the way down to one of the eight-pin PICs now available, such as the PIC12C671 and PIC12C672, both under \$4.00 US. Motorola has nothing even close to these.

Still, some of you may be more familiar and comfortable with the HC11's instruction set and architecture, and the first time you look the PIC over it may seem alien and primitive. Some years ago when I first read the PIC databooks, I had that same impression, but they have grown on me. Let me tell you why.

Tour de PIC

Since the PIC doesn't have all the fancy built-in addressing modes of the 68HC11 (which has over 300 instructions), some operations will require more PIC instructions to accomplish — but, then again, the PIC16F84 has only 35 instructions to begin with, so it's easy to memorize them all (see Table 1).

The F84 has most of the binary arithmetic instructions you expect in an eight-bit microcontroller, including adding, subtracting, incrementing, decrementing, and bit-wise logical operations. It doesn't have BCD math instructions, so those will have to be faked in software if you need them.

Of special interest to control freaks (that's you, the Amateur Robot Builder, bubba), the PIC has a

Miniature Transmitters and Receivers



RF300T
RF300XT



- ☐ 2 Button - 3 Channel Remote Control Transmitter
- ☐ 59,049 Changeable Security Codes - 10 Trinary Bits
- ☐ Operates at 318mhz
- ☐ 12 Volt Battery Incl.
- ☐ Size - 1.25" x 2"
- ☐ 1 Inch Keyring

	Qty	1	5	10
150' Range 2 Button Transmitter		24.95	20.95	16.95
300' Range 2 Button Transmitter		29.95	24.95	20.95

- ☐ 3 Channel Remote Control Receiver
- ☐ Input : 8-12vdc regulated or 11-24vdc unregulated
- ☐ Latched or Momentary Digital Outputs (x: L or M)
- ☐ PCB Board Size - 1.25" x 3.75"

RF300Rx	3 Channel Receiver	24.95	20.95	16.95
RF300RKx	3 Channel Receiver Kit	19.95	15.95	12.95

Visitect Inc. 510-651-1425

P.O. Box 14156 Fremont CA 94539 Fax 510-651-8454 Accept Visa, M/C, COD's



CABLEGUY'S OUTLET

A DIVISION OF J&S ENTERPRISES

- ALL CONVERTER MODELS AVAILABLE -
- WE SPECIALIZE IN ORIGINAL EQUIPMENT -
- SATISFACTION GUARANTEE -
- WHOLESALE DEALERS WELCOME -

CALL 24HRS - 1-888-446-4621

VISA, MC, & C.O.D.'S WELCOME

* ALL UNITS IN STOCK AND READY TO SHIP *

VISIT US ONLINE AT : www.j-s-enterprises.com

R/W-0	R/W-0	R/W-0	R-1	R-1	R/W-x	R/W-x	R/W-x
IRP	RP1	RP0	TO	PD	Z	DC	C

bit 7

bit 0

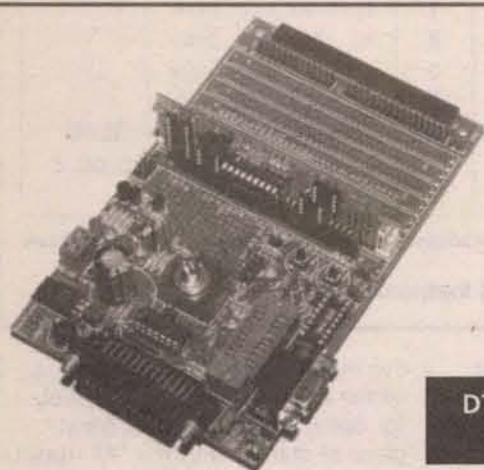
R = Readable bit

W = Writable bit

- n = Value at Power On Reset (POR)

- Bit 0:** **C:** Carry/Borrow bit
1 = Carry from msb of result occurred
0 = No carry from msb of result occurred
For subtraction, **C** behaves like a Positive flag that is set when the result is not less than zero, and cleared when the result is negative. For rotate instructions, **C** is loaded with either the high order bit (for **RLF**) or the low order bit (for **RRF**) of the source register.
- Bit 1:** **DC:** Digit Carry/Borrow bit
1 = Carry from bit 3 of result occurred
0 = No carry from bit 3 of result occurred
DC indicates when more than one 4-bit hex digit was necessary to accommodate the result. For subtract operations **DC** behaves in the same manner as **C**, except it operates only on the least significant nybble.
- Bit 2:** **Z:** Zero bit
1 = The result of an arithmetic or logic operation is zero
0 = The result of an arithmetic or logic operation is not zero
- Bit 3:** **PD:** Power-down bit
1 = After power-up or **CLRWDT** instruction
0 = After **SLEEP** instruction
- Bit 4:** **TO:** Time-out bit
1 = After power-up, **CLRWDT** instruction, or **SLEEP** instruction
0 = A Watch Dog Timer time-out occurred
- Bit 5-6:** **RP0, RP1:** Register Bank Select bits for direct addressing
00 = Bank 0: 00h - 7Fh
01 = Bank 1: 80h - FFh
10 = Bank 2: 100h - 17Fh (unimplemented on PIC16F84)
11 = Bank 3: 180h - 1FFh (unimplemented on PIC16F84)
Each bank is 128 bytes. Only **RP0** is used by PIC16F84; **RP1** should remain clear.
- Bit 7:** **IRP:** Register Bank Select bit for indirect addressing
0 = Bank 0, 1: 00h - FFh
1 = Bank 2, 3: 100h - 1FFh
IRP bit is not used by PIC16F84; and should remain clear.

Figure 3: File Status Register (FSR) Flags



DT001 WITH DT101 BOARD IN PROGRAMMING SLOT

ing of any individual writable bit in RAM without the need for sequences of ANDing or ORing an entire byte with a bit mask to isolate the one bit you are after. **BSF** and **BCF** are paired up with **BTFSS** and **BTFSC**, the bit test and skip instructions (more on these in a moment).

The PIC's branching instructions take a little getting used to. While the PIC

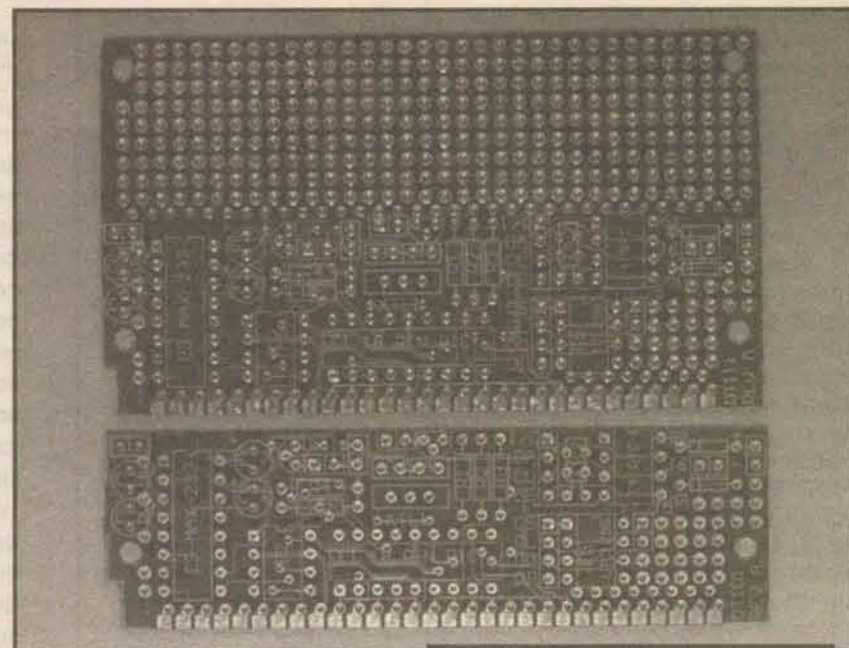
couple instructions — **BSF** and **BCF** — which allow direct setting or clear-

does have ordinary unconditional **GOTO**, **CALL**, and **RETURN**-type instructions, it has no true con-

ditional branching instructions. Instead, it has conditional *skipping* instructions, that is, instructions that skip over the instruction immediately following them when their conditional is satisfied. **DECFSZ**, for instance, skips the next instruction if, after decrementing a file register, the result is zero. **INCFSSZ** works the same way, except the file register is incremented. Two other skip instructions, **BTFSC** (bit test f, skip if clear) and **BTFSS** (bit test f, skip if set) do

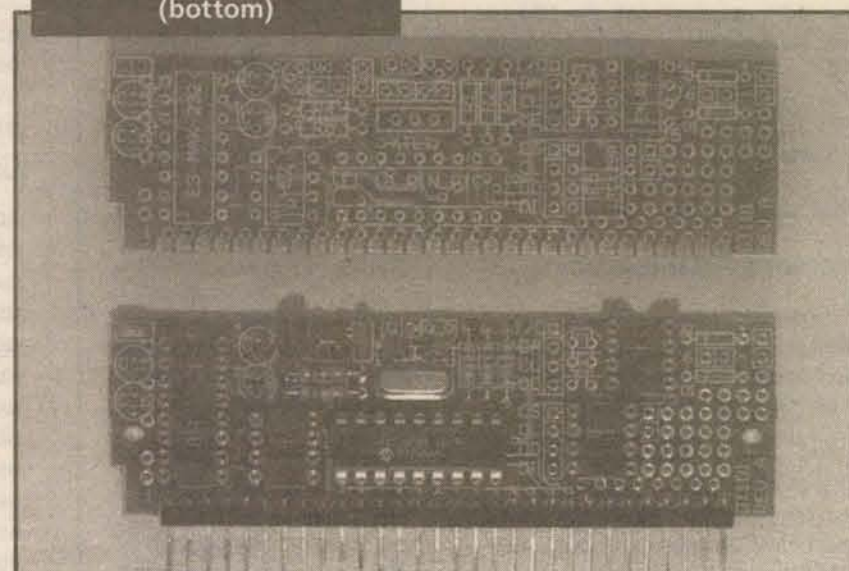
similar jobs, but their conditionals can be any bit in RAM, including bits in the STATUS register.

But to get true conditional branches, it does take two PIC instructions. Place an unconditional **GOTO** after any of the four skip-type instructions, and when the skip condition is true, the **GOTO** instruction is skipped and execution resumes with the instruction following the **GOTO**. Likewise, combining a skip with **CALL** or **RETURN** gives you con-



BARE DT101 (top) AND POPULATED BOARD (bottom)

DONTRONICS DT101 & DT111 SIMMSticks



\$\$\$ We Can Save You Money \$\$\$

Computers	PCB Manufacturing	PCB Assembly Services	Full Line Of Electronic Components
Custom Built PCs at the Lowest Prices Computer Accessories	Single & Double Sided	Board Stuffing Wave Soldering Acquisition of Parts	IC's Semiconductors Capacitors Resistors Sockets Relays Transistors & More
Call Chaffin Electronics Toll Free at (800) 442-2330			
WE WANT YOUR BUSINESS!!! BIG OR SMALL			
Phone (800) 442 2330	Fax (740) 354-9462	Email ceinc@zoomnet.net	Internet www.chaffinelectronics.com

Write in 48 on Reader Service Card.

Remote I/O Control

Model HCON-1

The perfect solution for
Home Automation
Temperature Monitor/Control
Remote Relay Control
Remote Equipment Control

Only \$119.00 plus shipping

J-Works, Inc

12328 Gladstone St., Unit 4
Sylmar, CA 91342
(818) 361-0787 Voice (818) 270-2413 Fax

RS-485 Full Duplex Communication
Up to 32 Devices Per Channel
Simple ACSII Command Set
1 to 20 Switch Input
20 Relay/LED Output 35ma
Quadrature Encoder Inputs
1-Wire Temperature Inputs
Dallas DS1820/21 Support
Input Power 8-15VDC
Small Size 1.9 X 2.8 Inches

Visit our Web site at
<http://www.j-works.com>
E-mail sales@j-works.com

Write in 85 on Reader Service Card.

Nuts & Volts Magazine/December 1998 87

ditional subroutine calls and returns.

Having to use two instructions to perform what most other processors do with one may seem to be a drag, but you get much more flexibility overall. Because they require two instructions to implement, conditional branches take up two program words, or 28 bits.

The nearest equivalent single-instruction branch in a 68HC11 would take up just 16 bits, or two bytes, one byte for the branch opcode and one byte for the relative branch address. But note that eight-bit relative branches only allow branches in the range from -128 to +127. For an HC11 conditional branch to access its entire memory range, as the PIC's skip/goto combination can, you need to combine a branch with the unconditional jump, a total of five bytes, or 40 bits. The PIC comes out the clear winner. For the same functionality, the PIC model takes up less chip real estate.

To complete this short tour of the PIC instruction set, the F84 has two housekeeping instructions, CLR-WDT which is the only instruction that can clear the Watch Dog Timer, and SLEEP, which puts the F84 into a lower-power standby mode.

That's it. Thirty-five instructions. That wasn't so bad, was it?

Harvard Architecture

The PIC family of microcontrollers are all examples of Harvard Architecture computers. This means they have separate program and data memory busses instead of the single memory bus used in traditional Von Neumann architecture machines. In Von Neumann machines, program and data are fetched over the same bus, and this makes the shared bus a bottleneck.

Having separate busses not only eliminates the bottleneck, it greatly simplifies the circuitry of the MPU and increases memory efficiency since the sizes of instruction and data words need not be the same. It also allows the MPU to simultaneously access both program instructions and data. This, combined with

efficient pipelining explains why PICs are so fast.

A PIC16F84 operating with a 10-MHz crystal has a 400 ns instruction cycle time, and all instructions execute in a single cycle, except instructions which change the program execution flow (i.e., branches, subroutine calls, and returns; these take two cycles).

Interrupt latency — the time it takes the PIC to respond to an interrupt — is very short, just three to four processor cycles, independent of the instruction being interrupted. For a 10-MHz system, this corresponds to a delay of 1.2 to 1.6 microseconds before interrupt processing begins. In contrast, a Motorola 68HC11 running at 8 MHz can take anywhere from two to 41 processor cycles — one to 20.5 microseconds — to begin processing an interrupt, which can introduce unacceptable jitter in some systems.

Another wrinkle of the PIC's Harvard architecture is that separate program and data memory spaces make it impossible for a PIC program to erroneously execute data. Neither can instructions in the program space accidentally be corrupted by data overwrites. This increases the resistance of the controller to electrical upsets common in control systems and makes for a more reliable system.

PIC Development Tools

Okay, assuming you're now at least interested in using PICs in robots, how do you program them?

Mnemonic, Operands	Description	Cycles	14-bit Opcode MSB LSB	Flags Affected
BYTE-ORIENTED FILE REGISTER OPERATIONS				
ADDWF f,d	Add W and f	1	00 0111 dfff ffff	C, DC, Z
ANDWF f,d	AND W with f	1	00 0101 dfff ffff	Z
CLRF f	Clear f	1	00 0001 1fff ffff	Z
CLRWF —	Clear W	1	00 0001 0000 0011	Z
COMF f,d	Complement f	1	00 1001 dfff ffff	Z
DECF f,d	Decrement f	1	00 0011 dfff ffff	Z
DECFSZ f,d	Decrement f, Skip if 0	1(2)	00 1011 dfff ffff	Z
INCF f,d	Increment f	1	00 1010 dfff ffff	Z
INCFSZ f,d	Increment f, Skip if 0	1(2)	00 1111 dfff ffff	Z
IORWF f,d	Inclusive OR W with f	1	00 0100 dfff ffff	Z
MOVF f,d	Move f	1	00 1000 dfff ffff	Z
MOVWF f	Move W to f	1	00 0000 1fff ffff	
NOP —	No Operation	1	00 0000 0xx0 0000	
RLF f,d	Rotate f Left through Carry	1	00 1101 dfff ffff	C
RRF f,d	Rotate f Right through Carry	1	00 1100 dfff ffff	C
SUBWF f,d	Subtract W from f	1	00 0010 dfff ffff	C, DC, Z
SWAPF f,d	Swap nybbles in f	1	00 1110 dfff ffff	Z
XORWF f,d	Exclusive OR W with f	1	00 0110 dfff ffff	Z
BIT-ORIENTED FILE REGISTER OPERATIONS				
BCF f,b	Bit Clear f	1	01 00bb bfff ffff	
BSF f,b	Bit Set f	1	01 01bb bfff ffff	
BTFSZ f,b	Bit Test f, Skip if Set	1(2)	01 10bb bfff ffff	
BTFSZ f,b	Bit Test f, Skip if Set	1(2)	01 11bb bfff ffff	
LITERAL AND CONTROL OPERATIONS				
ADDLW k	Add literal to W	1	11 111x kkkk kkkk	C, DC, Z
ANDLW k	AND literal with W	1	11 1001 kkkk kkkk	Z
CALL k	Call subroutine	2	10 0kkk kkkk kkkk	
CLRWD —	Clear Watchdog Timer	1	00 0000 0110 0100	TO, PD
GOTO k	Go to address	2	10 1kkk kkkk kkkk	
IORLW k	Inclusive OR literal with W	1	11 1000 kkkk kkkk	Z
MOVLW k	Move literal to W	1	11 00xx kkkk kkkk	
RETFIE —	Return From Interrupt	2	00 0000 0000 1001	
RETLW k	Return with literal in W	2	11 01xx kkkk kkkk	
RETURN —	Return from Subroutine	2	00 0000 0000 1000	
SLEEP —	Go into standby mode	1	00 0000 0110 0011	TO, PD
SUBLW k	Subtract W from literal	1	11 110x kkkk kkkk	C, DC, Z
XORLW k	Exclusive OR literal with W	1	11 1010 kkkk kkkk	Z

f = file address

d = dest: 0 for W, 1 for f

b = bit address

k = literal constant

x = don't care

Table 1: PIC16F84 Instruction Set

A quick search on the Web will get you hundreds of links, and you could spend months following all the interesting ones. To save you some time,

I've included a sidebar with my list of the best of what's on the Web for doing things PICish. A great place to start is with the "All About

Top Quality Reconditioned Electronic Test Equipment

Hewlett-Packard • Tektronix • Fluke • Wavetek

Buy • Sell • Rent • Trade

Shop our On-Line Catalog

<http://www.bellelect.com>

650-579-1711 • Fax 650-579-5777

Corporate Offices: Seattle WA 425-251-6653
1479 Rollins Road 285 S.W. 41st Street
Burlingame CA 94010 Renton WA 98055



BELL
Electronics

Looking for Test Equipment Manuals?

Contact: Manuals Plus (435)882-7188 • Fax (435)882-7195

<http://www.manualsplus.com>

ONE STOP SUPPLIER



MILLENNIUM
TRI 550
PANASONIC
JERROLD

"One call does it all"

1-888-426-9787

REMOTES

FILTERS

A DOZEN OTHER CONVERTERS AVAILABLE!

Call for Quantity Prices

Open Monday - Friday 10:00 a.m. - 5:00 p.m. Saturdays 10:00 a.m. - 1:00 p.m.

No Florida Sales • We ship same Day • 90 Day Limited Warranty

WE BEAT ANY ADVERTISED PRICE IN THIS MAGAZINE!

PIC" website. If this site doesn't point you to what you need, I don't know what will.

You'll be astonished at the sheer mass of PIC development software and hardware tools out there, from the expensive commercial development tool suites to the anarchic, homebrew, by-gosh-it-actually-works gear. Most of the latter is freeware or shareware, much of it surprisingly good.

First, you'll need an assembler of some kind. For Wintel users, one place to start is with the Mothership itself: the Microchip website. They have available for download a good macro assembler — MPASM — and a serviceable simulator — MPSIM. They also will gladly point you to higher-end tools such as emulators and optimizing C compilers.

For Macintosh users, there are several excellent software packages available. I've been using the Crossbow cross-assembler package for many years, long enough ago that I actually paid for it. I would kick myself now that it's available as freeware from Peripheral Issues, but it's an even better product covering more processors now than when it was commercial. It's an integrated editor, macro assembler, and downloader, and it assembles code for every common eight-bit processor out there (and a few uncommon ones, too).

I've also used MacPIC by Kevin Coble. It's shareware with an integrated editor, assembler, simulator/debugger, and downloader. Topnotch.

Next, you'll need some hardware to actually program the PICs. The sheer number of choices here will surely boggle your mind. Most programmers require a PC with a parallel port to operate, though a few use a serial interface (which Mac and Linux users will appreciate). No matter what your budget or performance needs, I guarantee you'll be able to find a programmer that will suit you.

Despite being a devoted Mac user, I don't yet own a serial port PIC programmer. I do, however, own and use two different parallel port programmers, the DonTronics DT001 and the Parallax PIC16Cxx-PGM (see photos). I use these with my toy computer, an embarrassing 386 DOS machine I keep in my basement so folks won't see it.

The DT001 can be configured to program individual chips, to program SIMMStick boards in-circuit, or to function as a SIMMStick motherboard, complete with expansion connectors and RS-232 communications. It's available as a bare PC board directly from DonTronics in Australia or from any of the numerous SIMMStick distributors world-wide. I've purchased boards and parts from both Don at DonTronics and Ben Wirz at Wirz Electronics; they're good people, with fast and courteous service.

The DT001 is well-documented and inexpensive to build. Recommended.

The Parallax PIC16Cxx-PGM costs a bit more than the DT001, but it comes already built and can handle a wider range of PIC chips, including the older 12-bit core family, which use a different programming method than Microchip's newer PICs. It's available in a "Hobbyist Pack" for \$109.00 US from Digi-Key (www.digikey.com).

With the Hobbyist Pack, you'll have to supply your own wall-wart power transformer, build the inter-

face cable, and print out the documentation yourself. This will cost you about \$10.00 and half an hour of your time, but when you are finished you'll have saved yourself over \$100.00.

Once you have an assembler, a programmer, and the software to run it, then you need a way to build the PIC into a circuit. There are scads of PIC breadboards out there. I have two favorites: the line of PICProto boards from microEngineering Labs and, of course, SIMMSticks.

Advanced Transdata Corp.

14330 Midway Rd.
Suite 128
Dallas, TX 75244
Tel: 972-980-2960
Fax: 972-980-2937
www.adv-transdata.com
(RICE17A in-circuit emulator, PGM16N and PGM2000 programmers)

"All About PIC" website
www.ornix.riga.lv/eng/mchip/mchip.htm
(Incredible number of links to PIC resources)

Byte Craft Ltd.

421 King Street
North Waterloo
Ontario, Canada N2K 4E4
Tel: 519-888-6911
Fax: 519-746-6751
www.bytecraft.com

CCS

P.O. Box 2542
Brookfield, WI 53008
Tel: 414-781-2794 x30
Fax: 414-781-3241
www.ccsinfo.com/picc.html
(PIC C compilers for DOS and Windows)

COMFILE Technology

Seoul, Korea
Tel: 82-2-711-2592
Fax: 82-2-711-2593
www.comfile.co.kr
(PIC12/14/16 Emulator/programmer)

Dallas Semiconductor

4401 South Beltwood Parkway
Dallas, TX 75244-3292
Tel: 972-371-4448
Fax: 972-371-3715
www.dalsemi.com
(Serial RTCs, temp. sensors, batt. monitors)

DonTronics

P.O. Box 595
Tullamarine 3043
Australia
Tel: +61 3 9338-6286
Fax: +61 3 9338-2935
dontronics.com
(SIMMStick PC boards, development systems, and software)

HI-TECH Software LLC

7830 Ellis Road
Suite 105
Melbourne, FL 39204
Tel: 1-800-735-5715
Fax: 407-722-2902
(HI-TECH PIC C compiler for the PIC16Cxx)

HI-TECH Software

P.O. Box 103
Alderley, QLD 4051
AUSTRALIA
Tel: +61 7 3354 2411
Fax: +61 7 3354 2422
(HI-TECH PIC C compiler for the PIC16Cxx)

ITU Technologies

3704 Cheviot Ave. Suite 3
Cincinnati, OH 45211

Tel: 1-888-448-8832, 513-661-7523

Fax: 513-661-7534

www.itutech.com

(PIC development systems, programmers, compilers)

Linear Technology Corporation

1630 McCarthy Blvd.
Milpitas, CA 95035-7417
Tel: 1-800-454-6327, 408-432-1900
Fax: 408-434-0507
www.linear-tech.com
(Serial A/D & D/A converters)

Linux RS-232 PIC programmer

by Jaakko Hyvatti
www.iki.fi/hyvatti/pic/picprog.html

MacPIC, by Kevin Coble

<ftp://ftp.srv.net/pub/users/kxc/>
(Macintosh shareware: integrated editor, assembler, simulator/debugger, and programmer for PIC microcontroller)

Microchip Technology, Inc.

Tel: 1-888-628-6247, 602-786-7200
Fax: 602-899-9210
www.microchip.com
(PIC chips, PICSTART development systems, MPASM assembler, MPSIM simulator, serial EEPROMs)

microEngineering Labs, Inc.

Box 7532
Colorado Springs, CO 80933
Tel: 719-520-5323
Fax: 719-520-1867
www.melabs.com
(PIC prototyping boards, EPIC programmer, PicBasic Pro Compiler)

Micro Mint

4 Park St.
Vernon, CT 06066
Tel: 1-800-635-3355, 860-871-6170
Fax: 860-872-2204
www.micromint.com
(PicStics & BASIC compiler)

Myke Predko

www.myke.com
(author of *Programming and Customizing the PIC Microcontroller*)

National Semiconductor Corp.

2900 Semiconductor Drive
Santa Clara, CA 95052-8090
Tel: 1-800-272-9959
TWX: 910-339-9240
www.national.com
(Serial A/D & D/A converters)

Parallax, Inc.

3805 Atherton Road, Ste. 102
Rocklin, CA 95765
Tel: 1-800-512-1024, 916-624-8333
www.parallaxinc.com
(PIC16Cxx-PGM programmer, SX-Key debugger/programmer, BASIC Stamps)

Peripheral Issues

P.O. Box 543
Mashpee, MA 02649
Tel: 508-563-7190
Fax: 508-563-7191
www.periph.com/crossbowweb/Crossbow.html
(Freeware Crossbow cross assembler for

More Options, More Options!

Among his many SIMMStick products, Don McKenzie of DonTronics fame has two great boards available — the DT101 and the newer DT111 — designed especially for 18-pin PICs such as the 16F84. The only difference between the two is the DT111 is a double-height SIMMStick with a nice proto-

PIC and SIMMStick Internet Resources:

the Macintosh)

RS-232 Serial PIC programmer project,

by Jens Madsen
www.gbar.dtu.dk/~c888600/newpic.htm

Scenix Semiconductor

3160 De La Cruz Blvd. Suite 200
Santa Clara, CA 95054
Tel: 408-327-8888
Fax: 408-327-8880
www.scenix.com
(SX18/20AC100 MCU chips, backward-compatible with PIC 16C5x)

Scott Edwards Electronics, Inc.

P.O. Box 160
Sierra Vista AZ 85636
Tel: 520-459-4802
Fax: 520-459-0623
www.seetron.com
(Counterfeit Stamp, SSC Serial Servo Controller, Serial LCD)

SIGNUM Systems

Thousand Oaks, CA
Tel: 1-800-838-8012
Fax: 805-371-4610
www.signum.com
(ICEPIC in-circuit emulator)

Sirius microSystems

172 Harvard Road
Waterloo
Ontario, Canada N2J 3V3
Tel: 519-886-4462
Fax: 519-886-4253
www.siriusmicro.com
(PIC development boards, programmers, assembler)

Square 1 Electronics

P.O. Box 501
Kelseyville, CA 95451
Tel: 707-279-8881
Fax: 707-279-8883
www.sq-1.com
("Easy PIC'n" & "PIC'n Up The Pace" books)

TechTools

P.O. Box 462101
Garland, TX 75046
Tel: 972-272-9392
Fax: 972-494-5814
www.tech-tools.com
(PICmicro in-circuit emulator, assembler)

Wirz Electronics SIMMSticks

P.O. Box 457
Littleton, MA 01460-0457
Tel: 1-888-289-9479
Fax: 978-448-0196
www.wirz.com
(SIMMSticks, SLI serial LCD interface, kits)

PICLIST List Server

The PICLIST is one of the most helpful resources for PICs on the Internet. To subscribe to the PICLIST, send an E-Mail to: listserv@mitvma.mit.edu with a blank subject line, and a body of SUB PICLIST. Be warned: there are thousands of people on this list, and it generates 200+ messages a day.

typing area added above the single-height DT101 layout. Both are high-quality boards with component placement silkscreen, solder mask, and heavy power and ground trace layout.

In the minimal configuration (see photo), these boards need only an F84 and either two 15 pF capacitors and a crystal or a three-pin ceramic resonator.

But there are many more options — "More options, more options!" seems to be Don's rallying cry — so you can choose according to your needs. There are four pre-wired options (all you have to do is solder the necessary components in place) and two more options requiring a few wire jumpers each to connect them to the rest of the circuit.

The first pre-wired option (PWO) you can add is a simple on-card voltage regulator. Don has thoughtfully provided pads on the regulator output where you can install a two-pin header; cut the trace between the pads, and then you can use a shorting jumper to isolate the output of the regulator circuit as needed.

This is necessary if you want to program the SIMMStick in-circuit on the DT001 programmer. The DT001 switches pin 7 of the SIMMStick bus (SS-Bus) between +5V and the programming voltage Vpp and, if you have an on-card regulator installed on the SIMMStick, you must temporarily isolate its output so it doesn't fight the programmer voltage.

The second PWO is to add two reset resistors and a pullup for the PIC's RTCC pin (pin 14, "IO," on the SS-Bus). You can also install a TO-92 package brown-out reset IC to put the F84 into reset when the power supply goes squirrely and voltage drops. I recommend installing the brown-out IC — robot power supplies are heinously noisy.

The third PWO is an eight-pin 24LCxx-type serial EEPROM. These I2C devices range in capacity from 1 to 64 Kbits and can be used for storing auxiliary data or tokens to be interpreted by a virtual machine programmed into the PIC.

This is the way the BS2 SIMMStick works, and Dunfield Development Systems (www.dunfield.com/catalog.html#cflea) has

CFLEA, an interpreted C that can use the same token storage approach.

The fourth PWO is an RS-232 serial level translator. Just add a MAX-232 chip and four 1 uF capacitors, and you get a standard RS-232 interface. Not as funky as the two-transistor method BASIC Stamps use, but it's reliable and full-duplex.

Finally, Don has provided two partially-wired options. The first is a place to put an eight-pin SPI or Microwire-type serial interface ADC or DAC. The second is a place to put an eight-pin, serial interface real-time clock/calendar chip, along with its 32.768 KHz crystal, and steering diodes for an optional 3V coin cell for battery backup.

Squashing the Learning Curve

If my rants above and the Web resources in the sidebar aren't enough for you to get going with PICs, then you'll need to hit the books. The bible for all PIC microcontrollers is Microchip's own *PIC16/17 Microcontroller Databook*. The writing is often turgid and the order of presentation sometimes confusing, but this book is the authority of last resort. The answer is in there — if you can find it and decipher it.

Fortunately, there are third-party books around to help you scale the steep learning curve. For those new to assembly language in general and to PICs in particular, I would recommend *Easy PIC'n* and the follow-up *PIC'n up the Pace* from Square 1 Electronics. These books will take you by the hand and very gently initiate you into the mysteries of PIC programming.

If you've already learned to program a few other microcontrollers, or if you just want something more assertive and meaty than the *PIC'n* books, then you might find *Programming and Customizing the PIC Microcontroller* (McGraw-Hill 1998, ISBN 0-07-913646-X) by Myke Predko more to your taste. It's my first choice, hands down.

And, if all this PIC stuff is making your head throb and kindling a desire to break things, I have just the gadget for you.

Mini Wire Bender

In my very first "Amateur Robotics Notebook" column (June '98), I described how to improvise a wire-bending jig from a hunk of wood and a couple wood screws. It works, but it takes some practice to get good bends. In a hobby shop, I came across a much easier way to bend music wire a couple months after I wrote that first column: the K&S Engineering Mini Wire Bender. This little beauty allows you to make accurate bends in solid brass or steel wire up to 1/8" diameter.

It's a two-piece unit, a steel base with a pivot pin and a clamping screw, and a torque handle that fits over the pivot pin. First you securely clamp the base in the jaws of a bench vise, then place the wire to be bent diagonally between the pivot pin and the clamping screw. Next, tighten the clamping screw to hold the wire in place, and fit the torque handle over the pivot pin. A short steel pin protrudes downward from the torque handle and engages the wire so that when you pull the handle back, the wire bends around the pivot pin. It produces a perfect radius and the wire doesn't even get nicked. Cost? Just \$10.00 US.

You should be able to find one of these in any well-stocked hobby shop. If you can't find one, try contacting the company directly:

K&S Engineering
6917 West 59th Street
Chicago, IL 60638
Tel: 773-586-8503
Fax: 773-586-8556

Forgotten Technologies

Robot builders — or thing-makers of any kind, for that matter — are always on the lookout for information about new techniques and tools to build oddball devices. Sometimes just knowing that a certain tool exists can inspire solutions to problems that seem unsolvable at first.

Sometimes the tools and techniques don't even have to be new to be of help. In fact, sometimes the older and more obscure the stuff is, the more readily it can be adapted

and used by the amateur. These "forgotten" technologies use old tools and methods that are often cheaper and more easily understood than modern processes.

I spend a lot of time browsing books, magazines, and websites looking for these little kernels of forgotten tech. This month, I came across a treasure trove: John Strong's 1938 *Procedures in Experimental Physics*. It was out of print until 1986 when Lindsay Publications reprinted it under their "Lost Technology" series (ISBN 0-917914-56-2). At \$25.95 US, it's a bargain.

In Strong's book, you'll find detailed drawings and hands-on descriptions of doing laboratory glass-blowing, working with high vacuum, making optical instruments, Geiger tubes, photometers, electrometers, and many other devices, exotic and mundane. The book is old enough that many of these techniques aren't taught anymore, not because they aren't useful, but because they can't be as readily automated or are too expensive for mass production. But for one-off work, they can be ideal. Browse through this book and dream of what you could make.

Lindsay Publications specializes in books that encourage not only dreaming but doing. Just reading their catalog alone is inspirational. Check out their website at www.lindsaybooks.com. Order their catalogs. You won't be disappointed.

Enough, Already!

That's all my space. Next time, I'll give Breadbot its fourth brain transplant, program the new brain, and add some spiffy wheel rotation sensors. **NV**

As always, if you have suggestions for improving Breadbot, if you've built a Breadbot, or if you have questions or comments about amateur robotics topics, you can reach me at:

Robert Nansel

69 S. Fremont Ave. #2
Pittsburgh, PA 15202

E-Mail: bnansel@nauticom.net

SOLUTIONS TO YOUR CABLING NEEDS

Cat.5 -- Enhanced Cat.5 -- USB -- IEEE1284 / 488 / 1394
Firewire -- High-End Monitor -- Manual & Auto Switches
Apple -- Custom Ribbon Cables -- Premise Wiring -- more!
HUGE SELECTION OF SCSI CABLES & ADAPTERS

USB Hubs & Printer Cables Are Here!

4-port hub, dual power...\$60.00
USB to Parallel printer cable...\$52.00

No minimum order, same day shipping on most orders, A+ and CET technician available to answer your questions.



Northwest Cable & Connector Co.
www.nwcable.com



Phone: (360) 754-3606 Fax: (360) 754-0825

Lowest Dealer Price Available

	5+	10+	20+
Refurb. Panasonic 145	\$45	\$40	\$35
Panasonic 175	\$70	\$68	\$65
Regal w/Remote	\$38	\$35	\$30
BC4535 86 Channel	\$30	\$28	\$25
Oak Sigma 99 Channel	\$45	\$40	\$35
75 Channel Converter	\$18	\$18	\$18
Zenith ST1600 w/Remote	\$75	\$70	\$65

Call us today to satisfy all your cable equipment needs!

SAM'S ELECTRONICS
1-405-631-1856

All Cable Equipment is unmodified.

New Product News

Continued from page 4

EDE702 SERIAL LCD INTERFACE IC

E-Lab Digital Engineering, Inc. announces the release of their new EDE702 Serial LCD Interface IC.

This IC has been especially designed for cost-sensitive OEM applications, allowing nearly any text-based liquid crystal display screen to be controlled via a one-wire serial link — ideal for embedded microcontroller applications where minimal I/O pin usage is desired.

The EDE702 allows full LCD control, including the creation of custom characters, scrolling text, cursor on/off, etc.

With 2400/9600 baud rate and selectable data polarity, the EDE702 can interface to nearly any microcontroller capable of sending asynchronous serial data, and connection can be made without any type of voltage level conversion hardware.

The EDE702 allows circuit designers to easily add a LCD screen to their design



without the increased software overhead or I/O requirements accompanying the usual 11-pin LCD interface.

A serially-controlled digital output pin on the EDE702 makes its one-pin serially interface effectively a zero-pin interface! Eighteen pin DIP or SOIC packages are available; 1K pricing is \$4.50

For more information, contact:

E-LAB DIGITAL ENGINEERING, INC.
1600 N. 291 HWY. STE. 339 DEPT. NV
INDEPENDENCE, MO 64056
816-257-9954 FAX: 816-257-9945
WEB: <http://www.elabinc.com>
E-MAIL: support@elabinc.com



SBC-1 EMBEDDED CONTROLLER

Industrologic is now shipping its SBC-1 embedded controller. This 80C51 system presents a menu-driven operating system that includes complete diagnostic and system functions such as user program upload and download, and remains onboard and usable for the life of the product.

Size is 5" x 8", I/O signals total 50 (26 I/ 24 O).

A module rack (50-pin header) interface is included, as well as two RS232 connectors, eight-bit analog input, real-time clock, system support for assembled and compiled programs, and an

enhanced TinyBASIC interpreter in ROM that has debug, load and save, and I/O commands. All features listed are standard.

A full developer kit with board, manual, supply, serial cable, and software diskette is \$179.00.

For more information, contact:

INDUSTROLOGIC, INC.
3201 HIGHGATE LN., DEPT. NV, ST. CHARLES, MO 63301
314-707-8818 WEB: www.industrologic.com

KENWOOD CS-5300 SERIES ANALOG OSCILLOSCOPES

Products Intl., Inc. introduces the new CS-5300 series of analog oscilloscopes from Kenwood. These oscilloscopes are available in either 50 MHz or 100 MHz, with or without cursors, and readouts.

The CS-5300 series does not use multi-function knobs. Thus, an inexperienced person may use it easily. Straightforward switch layout on the panel eliminates errors even on complicated operations.

The CS-5300 series also feature: Automatic setup of both horizontal and vertical axis (CS-5370/5350), with the models with readout function, waveforms can be displayed in optimum sizes by simply pressing the auto button once.

Automatic measurements of voltage and

frequency (CS-5370/5350), even analog oscilloscopes, these models are capable of measuring the parameters of input signals automatically.

Plus/minus 2% accuracy with both horizontal and vertical axis, all of the four models achieve high measurement accuracy of 2%.

Multi-trace display of any desired channel.

Relay attenuator with improved reliability. For more information, contact:

PRODUCTS INTL., INC.
8931 BROOKVILLE RD.
DEPT. NV
SILVER SPRING, MD 20910
301-587-7824 FAX: 301-585-5402
1-800-638-2020
E-MAIL: scott@prodintl.com

NEW DUAL DISPLAY MULTIMETER

Terma Test Equipment announces the introduction of their new Model 72-6558 Professional Dual Display True RMS Multimeter; available from MCM Electronics.

The multimeter's features are: Dual 5-1/2 digit back-lit LCD display with analog bargraph; simultaneous measurement of two different parameters of the same signal; selectable count resolution of 200,000, 20,000, and 2,000; measures AC and DC voltage and current, resistance, frequency, capacitance, and temperature; true RMS AC

and AC+DC measurement; and 1000V maximum DC measurement with 1mV resolution and 0.01% accuracy.

The new model 72-6558 at only \$579.00 also includes an RS-232 interface and can be used in IEEE systems with optional IEEE-488 GPIB interface.

For more information, contact:

MCM ELECTRONICS
650 CONGRESS PARK DR., DEPT. NV, CENTERVILLE, OH 45459
937-434-0031 FAX: 937-434-6959 1-800-543-4330
WEB: www.mcmelectronics.com



BIRDWATCHER II

Glentech, Inc. introduces the BIRDWATCHER II, the first dial-in remote sensing interface for the Bird Model 43 wattmeter.

The BIRDWATCHER II and included software allows remote RF data access by simply plugging the wattmeter into a telephone line. BIRDWATCHER II software provides a big screen analog and digital remote sensing display from anywhere in the world.

The fully assembled and tested BIRDWATCHER II PC board mounts on the meter terminals of the wattmeter and has two modes of operation. In the bypassed mode, the wattmeter operates in its original

configuration without degradation. In the enhanced operation mode, the wattmeter is interfaced with the telephone line allowing for full digital and analog computer screen display of wattmeter measurement and movement.

Supplied with a custom back panel for the Model 43, all modifications are completely reversible.

The BIRDWATCHER II with dial-in telephone interface is priced at \$249.95 and BIRDWATCHER I (serial interface) is priced at \$149.95. Both come fully assembled and tested. For more information, contact:

GLENTech, INC.
731 W. LUNT AVE., DEPT. NV, SCHAUMBURG, IL 60193
847-891-2584 FAX: 847-891-2587
WEB: <http://www.glentech-rf.com>

MODEL 12086 FILTER

The model 12086 eliminates harmonic interference at the C-band receive antenna with a low loss of 0.05 dB to the pass-band (3.7 to 4.2 GHz).

The filter installs between the feedhorn and low-noise amplifier to suppress the band of 5.925 to 6.425 GHz with a minimum rejection of 50 dB. The unit has a VSWR of 1.08:1. Grooved flanges are standard, but other connectors are available upon request.

For more information, contact:

MICROWAVE FILTER COMPANY, INC.
6743 KINNE ST., DEPT. NV
EAST SYRACUSE, NY 13057
315-438-4747 FAX: 315-463-1467 1-800-448-1666
E-MAIL: mfcsales@microwavefilter.com
WEB: <http://www.microwavefilter.com>

A LICENSE FOR MAKING MONEY

by Gordon West

How would you like to earn \$1,000.00 a day by conducting a couple of ship radio station inspections aboard commercial boats required by law to carry marine radio equipment onboard? While this "make \$1,000.00 a day as a licensed technician" sounds like a sales pitch for a training school, this deal is FOR REAL! The FCC has turned over ship radio inspections to a very limited number of marine electronics technicians who hold the required Global Marine Distress Safety System (GMDSS) maintainer's license, FCC test Element 9.

"Effective July 1, 1998, the Commission (FCC) will no longer be conducting ship (radio) inspections," reports J.R. Zoulek, District Director, Federal Communications Commission, Los Angeles, CA.

"The FCC inspects approximately 1,210 vessels each year. To be in compliance with the current rules that require that all inspections be conducted by the Commission, the FCC has had to hire part-time ship inspectors in remote areas ... to travel great distances to inspect radio stations on US ships. The new rules will relieve the FCC of these manpower and financial burdens, while permitting vessels the more convenient and cost-effective alternative of using FCC-licensed technicians from the private sector for inspections," comments the FCC in a recent news bulletin.

The typical FCC fee for inspecting the radio station of a US vessel transporting more than six passengers for hire was \$320.00, and the average time onboard might be less than an hour. For ocean-going vessels, the fee was \$620.00, and the inspection time might take all morning or it might take all afternoon. But if everything was in order, it might only take a couple of hours!

"And arranging for the old FCC ship radio station inspection required months of pre-planning, scheduling, and pre-payment to the Commission," comments Daniel Freniere, captain of CALIFORNIA RESPONDER, a giant oil spill emergency response vessel out of Port Hueneme, CA. "We think that ship radio inspection privatization will be good for everyone," adds Freniere who holds a marine radio operator's permit (Element 1), as well as the GMDSS radio operator license (Element 7).

FCC COMMERCIAL RADIO LICENSE ELEMENTS

In 1993, the FCC turned over commercial radio license examinations to the private sector. The commercial radio license testing would operate very much like the amateur and aeronautical testing systems after which it was patterned. The old radiotelephone first class, sec-

ond class, and third class licenses had already been combined into the big general radio operator license 10 years earlier. The marine radio telegraph license was still on the books, but there weren't many applicants going for this outmoded means of communications. The ship radar endorsement was kept active, and the broadcast and aircraft endorsements were dropped.

The FCC ADDED the global marine distress and safety system operator's license for operation of the new satellite-based marine emergency sub-systems and equipment. This license will eventually replace all of the Morse Code operator certificates.

The FCC also added the global marine dis-

ment found in airplanes and on boats. The GROL license with radar endorsement is usually a requirement for getting into land mobile radio repair, although the FCC no longer requires land mobile radio techs to hold a commercial license. But many employers will look for an applicant with GROL with radar, as opposed to an applicant who may have no FCC license.

But the GROL won't qualify the technician for the new type of satellite-based equipment going aboard pleasure yachts, small commercial boats, and small and large passenger ships

The Federal Communications Commission (FCC) commercial general radiotelephone operator license (GROL) lets you repair and adjust aeronautical and marine radio transmitters. The radar endorsement gives you legal access to fix the microwaves. But the granddaddy of them all — GMDSS maintainer — gets you into a brand new market of ship radio station inspections that the FCC has just privatized ...

who are not required by GMDSS laws to carry specific pieces of satellite or terrestrial emergency radio equipment onboard. All United

States cargo and other commercial vessels, regardless of their area of operation, are required to be GMDSS compliant by February 1, 1999, if they are over 300 gross tons. Boats carrying more than 12 passengers for hire and operating on international voyages are also required to be GMDSS compliant by this date.

Vessels carrying more than six passengers operating in local waters may not be required to be GMDSS compliant, BUT ARE SUBJECT TO OTHER RADIO AND LICENSING REQUIREMENTS and the operator must hold, as a minimum, a marine radio operator's permit, Element 1. Small com-

mercial vessels and recreational vessels are not required to outfit for GMDSS, but may use this equipment on a voluntary basis without any operator licensing requirements. In other words, pleasure craft may not need this satellite-type equipment, but if there are any adjustments to the two-way radios onboard, they must be made by a licensed technician holding a GROL permit.

The designated GMDSS operator onboard one of the commercial vessels will be required to hold the GMDSS radio operator's license, test Elements 1 and 7. Element 7 is a question pool of 444 multiple-choice questions of which 76 will be on the test. Seventy-five (75) percent passing grade is required, and these test elements tend to be more about procedures with very little super-technical questions on amps, volts, or Ohm's Law. Element 1 is the maritime radio rules and regs. Both question pools can be studied and passed with about two or three weeks of reviewing the question pools.

THE INSPECTOR'S LICENSE

To cash in on the new lucrative inspection business, you will need to hold written Element 1, rules and regs; written Element 3, the GROL technical element; and Element 9, the GMDSS radio maintainer element, based on a pool of



BIG SHIP RADIO INSPECTIONS MAY TAKE SEVERAL HOURS AT \$75.00 AN HOUR.

stress and safety system MAINTAINERS license necessary for the repair, INSPECTION, and maintenance of satellite-based marine emergency sub-systems and equipment.

The natural progression for the study, testing, and starting employment in the marine and aviation market would be to first obtain the general radiotelephone operator license (GROL) with radar endorsement.

Element 1

Marine radio operator permit (MROP), 24-question, multiple-choice exam on rules & regulations

Element 3

General radiotelephone operator license (GROL), 76-question exam on basic radio electronics

Element 8

Ship radar endorsement, 50-question written examination on ship and aviation radar equipment

Successfully passing each of the three elements (Element 1, Element 3, and Element 8) leads the applicant to the important GROL license with radar endorsement. This allows the marine and aviation electronics technician to work on conventional radio and radar equip-

RADIO INSPECTORS WILL NEED TO BE FAMILIAR WITH GMDSS TERMINALS.



250 questions of which 50 technical questions will be on the test.

It is recommended that applicants first prepare and pass written Elements 1, 3, and radar endorsement, Element 8. These 3 elements can be found in the \$34.95 soft-covered book, *GROL PLUS*, written by Gordon West and available for \$30.00 from Gordon West

The FCC reports there are over 4,000 GMDSS licensed operators who have passed the test as of August of this year, but only 850 GMDSS maintainer licenses that could allow the license holder to become a ship radio station inspector.

"The Global Maritime Distress and Safety System (GMDSS) replaces the ship-to-ship safety system that used manual Morse Code with a ship-to-shore safety system that used satellite and automated terrestrial communications systems," comments George Dillon with the FCC in Washington, DC. "The FCC requires specific classes of licenses for the inspection of certain categories of ship radio stations. Inspection of cargo vessels or passenger vessels equipped with GMDSS equipment must be conducted by an FCC-licensed technician holding a GMDSS radio maintainer's license," adds Dillon (Internet address: gdillon@fcc.gov).

The vessel owners and operators most likely have a clear picture on whether or not they require periodic ship radio station inspection. In the past they have been inspected by the FCC, but now they are told the FCC no longer conducts these inspections and they must go to the private sector. And here is where you

come in. If you hold the GMDSS radio maintainer's license, along with the very necessary MROP, GROL, and radar endorsement, not only can you give inspections, but you could also do

technical repairs and adjustments on the spot to bring the vessel up to full compliance. Plus getting the word out that you are the local fixer and inspector is going to be tough unless you are already signed up with a local marine electronics dealer who regularly goes aboard commercial boats to adjust the radio apparatus.

"You might look in the yellow pages under marine radio inspectors," comments the FCC out of a local Southern California office. "Or maybe post notices where they might be read by big ship operators," adds the FCC. I recommend visiting your local marine electronics dealer, and working out a plan where you could offer an inspection if they don't already have a GMDSS radio maintainer on staff.

You should also begin working with the national GMDSS implementation task force.

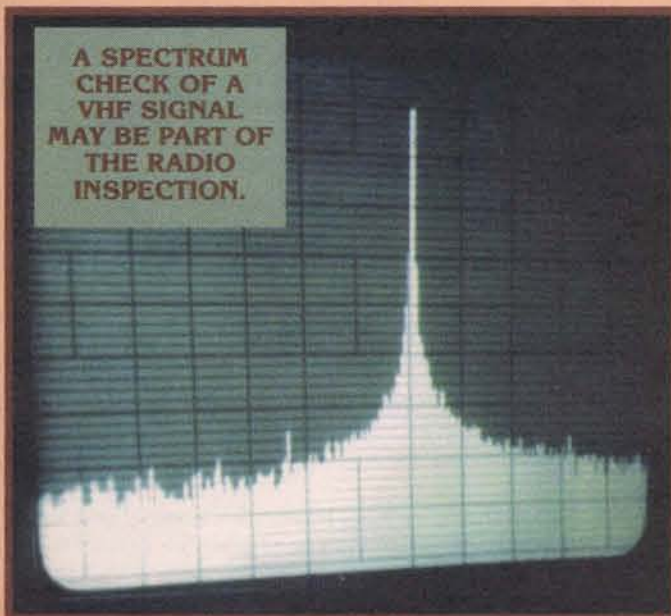
Jack Fuechsel, Executive Director
7425 Elgar Street
Springfield, VA 22151

"The national GMDSS implementation task force was chartered by the US Coast Guard to supplement government functions in expediting the implementation of the global maritime distress and safety system now being introduced by the International Maritime Organization (IMO)," comments Captain Fuechsel, Executive Director. "We have written to the Coast Guard Auxiliary and to the US Power Squadrons asking them to incorporate GMDSS and especially VHF-DSC (digital selective calling) in their public education courses. Your readers can find most GMDSS task force information bulletins and other documents on the Coast Guard's Internet web site at <http://www.navcen.uscg.mil/narcomms.htm>," adds Fuechsel.

As more big ship and medium-sized yacht communications go from microphone to keyboard, there will be a greater need for qualified marine electronic technicians with a strong background in satellite and digital communications.

Becoming a ship radio station inspector could earn good financial rewards once the word gets out that you are a competent inspector with the capabilities of offering repairs or board replacements right on the spot. But I would strongly suggest you work closely with a big marine electronics provider so the compulsory-equipped big boat operators will know who to contact for inspections and maintenance. Get started with the GROL Elements 1, 3, and radar endorsement 8. Take these tests in one sitting, and then tackle Elements 7 and 9. Having these licenses could lead to an exciting career in marine electronics and commercial ship radio station inspections. **NV**

A SPECTRUM CHECK OF A VHF SIGNAL MAY BE PART OF THE RADIO INSPECTION.



Radio School, 2414 College Drive, Costa Mesa, CA 92626. (Please add \$3.00 for Priority Mail, and I am happy to autograph the book for you!) It contains every question, the four multiple-choice answers, a description of the correct answer and how to solve technical questions mathematically, and is your one big source for getting through your marine radio operator's permit and general radio operator license with radar endorsement in one soft-cover copy.

Testing is offered by private commercial operator license examination managers throughout the country, and there are phone numbers to call to locate an examiner or examination team near you. And you can even call ME if you have technical questions about problem-solving within the book!

But you will need to study and pass the more technical GMDSS MAINTAINER 50-question test. If you would like a complete booklet on all of the GMDSS operator and maintainer test questions, along with the correct answer, send an additional \$10.00 and I'll include them with my GROL book!

CATEGORY OF VESSEL	MINIMUM CLASS OF FCC LICENSE REQUIRED BY PRIVATE SECTOR TECHNICIAN TO CONDUCT INSPECTION — ONLY ONE LICENSE REQUIRED			
	General Radiotelephone Operator License	GMDSS Radio Maintainer's License	Second Class Radiotelegraph Operator's Certificate	First Class Radiotelegraph Operator's Certificate
Radiotelephone equipped vessels subject to 47 CFR subpart R or S	✓	✓	✓	✓
Radiotelegraph equipped vessels subject to 47 CFR subpart Q			✓	✓
GMDSS equipped vessels subject to 47 CFR subpart W or subpart Q		✓		

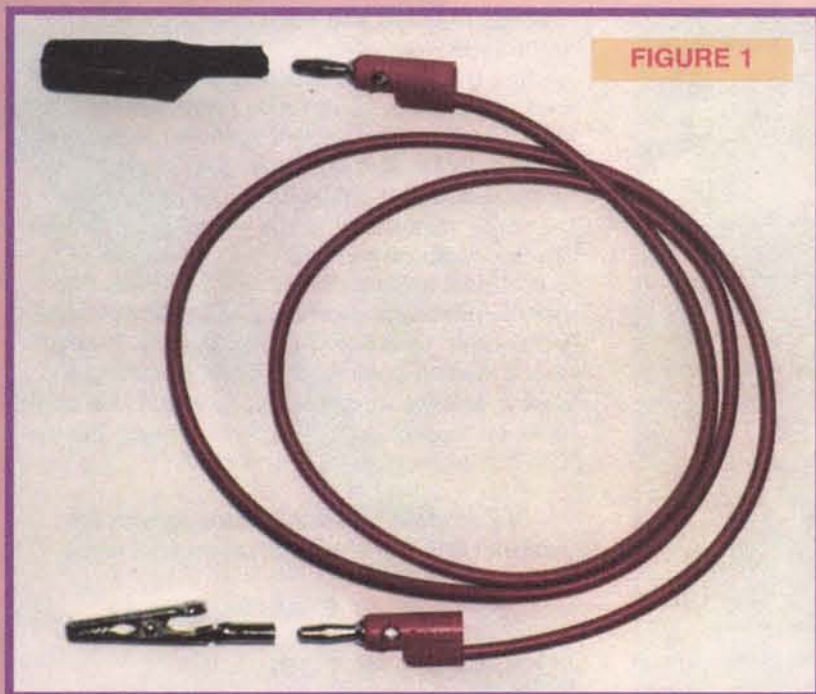


FIGURE 1

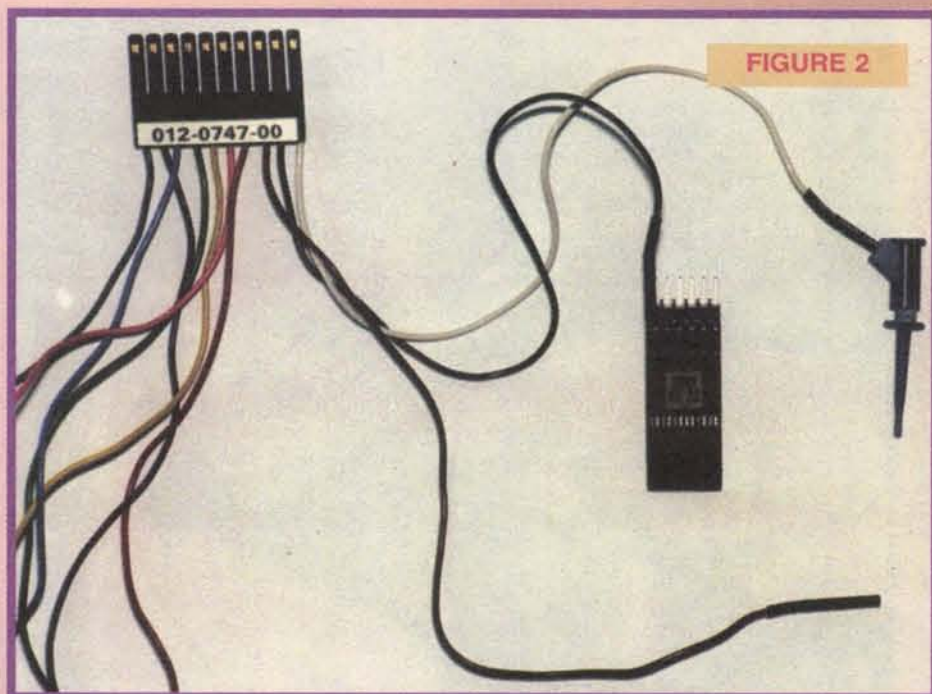


FIGURE 2

INTRODUCTION

It's pretty hard to get excited about a bunch of low-tech wires, but they are necessary. Using the wrong cables creates clumsy connections that take a long time to make, fall apart when you

supply leads. Some alligator clips and insulating boots turn the patch cords into alligator clip leads.

The middle number in Table 1 is the length in inches, and the last number is the color code (Pomona uses the resistor color code). I have a

ets because they mate with ribbon cable headers and the posts on IC test clips (see Figure 2). It's silly to have hooks flopping off an IC test clip. Furthermore, you can get grabbers with 0.025-inch posts to put on the end of these leads — just

Test Leads

by Gerald Roylance

breathe on them, and compromise measurements. Good leads make solid electrical and mechanical connections. A well-equipped lab needs a wide selection of test leads to connect power supplies, signal generators, and oscilloscopes to circuits being tested.

Test leads can be split into two broad categories: single leads (e.g., clip leads) and shielded cables (e.g., coaxial cables). For each category, I will describe what is useful and suggest products. Part numbers and approximate prices are included.

SINGLE LEADS

Ordinary leads are separate wires that are used to connect power supplies, make DVM measurements, or clip in debugging components such as potentiometers or capacitors. Heavy gauge wire is needed for power supplies and high current measurements, and delicate clips are needed for small components.

Banana Plugs and Alligator Clips

In the old days, test leads were almost always some combination of pin plugs, banana plugs, and alligator clips. Pin plugs have pretty much disappeared, and instead of having all combinations of banana plugs and alligator clips, it makes more sense to have a collection of banana plug leads and separate alligator clips that slip onto the banana plugs (see Figure 1).

For many years, ITT Pomona has made stackable banana plug leads (Pomona calls them patch cords) that are ideal for this purpose. These patch cords use 18-gauge wire, so they are good power

wide selection of patch cords in several lengths and colors. Short lengths are not used often, but they are good for connecting chassis grounds to isolated supply terminals, for example. To get from an instrument to a prototype needs 24-inch leads if they are on the same surface (e.g., the bench top). Longer leads (36 to 48 inches) are needed to go from a shelf above the table to the bench or from an instrument cart to the table. If the leads are too long, then they tangle and get in the way.

Hooks and Grabbers

Components are smaller these days, so banana plugs and alligator clips are too large for signal connections. Hooks (also called grabbers) are now more common than alligator clips, and they come in many sizes. Pomona's tradenames are Minigrabber, Micrograbber, and SMD Grabber, and single leads cost from \$4.00 to \$6.00 each.

When I needed several small clip leads, I bought a set of five small, 16-inch hooks (Philmore No. 500, IC Test Leads). The set was cheap (only \$10.00), but it has given me lots of trouble. The leads use solid instead of stranded wire, so the leads are stiff and less reliable. One lead became intermittent when I was tuning some 7th order elliptic filters for a client; that failure cost much more than the whole set. I do not recommend the Philmore leads, but I continue to use it — warily.

Someday soon I will replace the Philmore set with some leads that have sockets for 0.025-inch posts. Most logic analyzer leads use these sock-

like putting alligator clips on the end of banana plugs.

SHIELDED CABLES AND ADAPTERS

Some labs have huge collections of test leads to cover the wide variety of possible connections: BNC to banana plugs, BNC to hooks, BNC to alligator clips. The enormous variety is due to the profusion of different connectors. If we limit the domain to just RF connectors, then there are the common BNC, TNC, N, F, and SMA families. Add to that list the more exotic RF connectors, such as SMB, SMC, and the ultra-serious APC-7. Older RF equipment needs UHF, GR, and BSM connectors. Having test leads for all possibilities requires a lot of space and is expensive.

The saner approach is to own a selection of standard cables of different lengths and use adapters. My standard cables are BNC male on each end and range from 12 to 60 inches long. BNC cables are an obvious choice because most

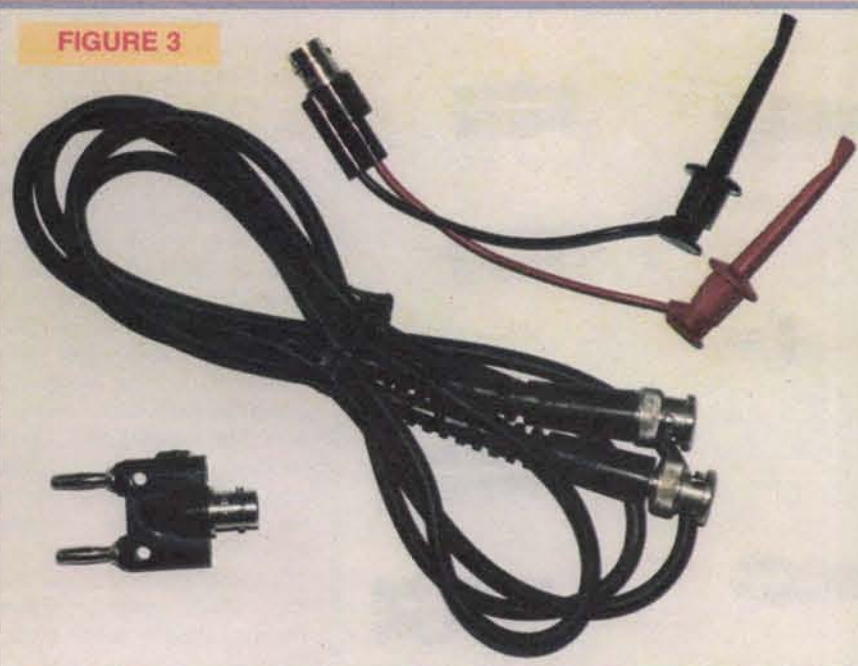
Patch cord, 24in, black	Pomona B-24-0	\$3.70
Patch cord, 24in, red	Pomona B-24-2	\$3.70
Alligator Clips (10 pack)	Pomona 2240	\$6.00

TABLE 1

0.025 inch patch cords	Pomona 4741-6*	\$3.55
Kit of 10	Pomona 5948	\$20.90
Micrograbber with 0.025 post	Pomona 4521*	\$2.50
Kit of 10	Pomona 5925	\$22.50

TABLE 2

FIGURE 3



of my test equipment uses BNC connectors. BNC connectors are rugged, mate quickly, and have reasonable RF performance. In contrast, F connectors are fragile, take a long time to screw on, and destroy your fingers. Most of my cables are 50-ohm RG-58, but some are RG-174 (thin) or RG-59 (75-ohm).

Standard cables and an array of adapters save money and clutter. An adapter usually costs less than a cable, takes less space, and won't tangle. With a small set of adapters, you can cobble together a cable with unusual connectors, such as an F connector to RCA phonograph plug — something I actually had to do when I connected a folded dipole antenna to a cheap receiver.

BNC Cables

Reliability is important, so all my BNC cables have crimp connectors. Clamp connectors are less rugged and more likely to be improperly assembled. At one place I worked, intermittent clamp connectors caused so much grief that any suspicion demanded instant amputation. I would stay away from twist-on connectors for lab work, but I have used twist-on F connectors for TV installations.

Buying BNC Cables

Good BNC cables are not expen-

sive. I bought most of my BNC cables at surplus stores. The price is about \$5.00 for a used cable, but I have paid as little as \$2.00. The main features of surplus cables are quality connectors and professional construction. New cables from ITT Pomona Electronics sell for about \$12.00 per cable; the last two digits in Table 3 specify the length in inches.

Making BNC Cables

You can make your own cables, but consider the total cost and the reliability. You must make several cables to cover the tooling cost. If your

BNC Cable, 12inch	Pomona 2249-C-12	\$11.75
BNC Cable, 24inch	Pomona 2249-C-24	\$11.75
BNC Cable, 36inch	Pomona 2249-C-36	\$11.75
BNC Cable, 48inch	Pomona 2249-C-48	\$14.65
BNC Cable, 60inch	Pomona 2249-C-60	\$14.65

TABLE 3

IDEAL CRIMPMASTER

Frame+Die	Die Only	Cable	Connector Family	Cavity Sizes
30-483	30-578	RG6, RG59	BNC and TNC	.324, .255, .068, .042
30-484	30-587	RG58, RG174	BNC and TNC	.213, .178, .068, .042
30-502	30-581	RG58, RG59/62	BNC and TNC	
30-503	30-582	RG6, RG59	F	
30-482	30-577	RG8/11	N	

TABLE 4

Feed-through terminator Terminator

Pomona 4119-50	\$45.00
Halted #971LB	\$1.49

TABLE 5

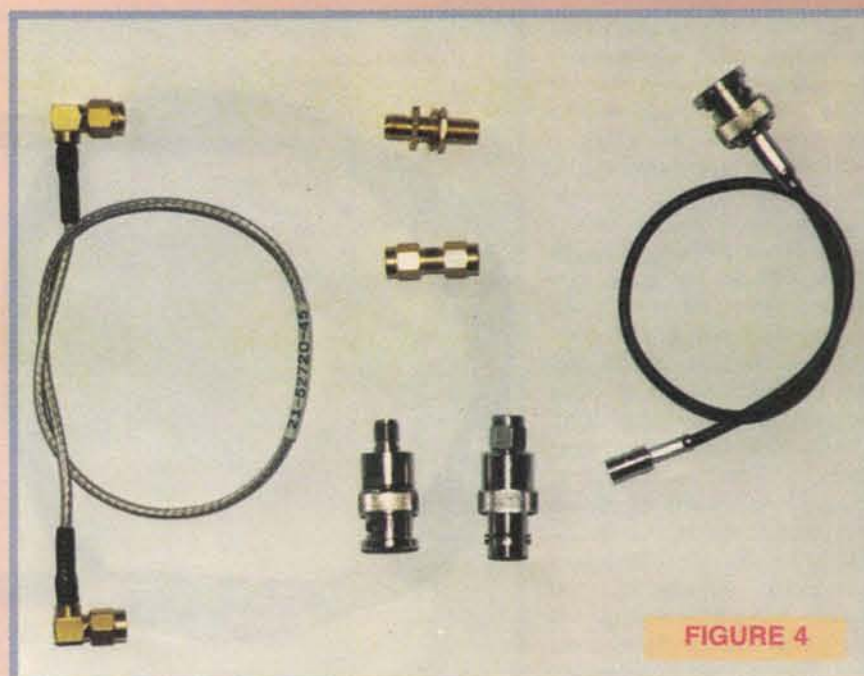


FIGURE 4

assembly skills are poor, then you will end up distrusting the cables and amputating suspect connectors.

A crimp tool with the appropriate die for the coax and connector is a necessity. The better crimp tools have ratchets to guarantee a complete crimp cycle (the military demands ratchets). An Ideal Crimpmaster with one die costs about \$55.00. The Crimpmaster uses interchangeable dies, so it can cover several different cables and connectors. You can buy no-name crimp tools for about \$25.00, but finding additional dies is difficult.

The dies will have at least two cavities. The large cavity is for crimping the braid, and the coax cable determines its size. The smaller cavity is for the center pin, and the connector type determines its size. Crimp tools that don't have a cavity to crimp the center-pin are useless. Crimping the center pin with a pair of pliers is not an option.

Ideal Crimp Tools

A cable-stripping tool may be handy, but I have had poor luck with them. I have tried a half dozen different models, but only found one that worked well, and it was

for RG8. The others required delicate adjustments, and I spent more time adjusting the stripper than using it. By the way, before stripping a cable, lightly roll the end on the floor with

PRINTED CIRCUIT BOARDS

QUALITY PRODUCT
FAST DELIVERY
COMPETITIVE PRICING

- * UL approved
- * Single & Double sided
- * Multilayers to 8 layer
- * SMOBC
- * LPI mask
- * Through hole or SMT
- * Nickel & Gold Plating
- * Routing or scoring
- * Electrical Testing
- * Artwork or CAD data
- * Fast quotes

**PROTOTYPE THROUGH
PRODUCTION**

PULSAR, INC

9901 W. Pacific Ave.
Franklin Park, IL 60131
Phone 847.233.0012
Fax 847.233.0013
Modem 847.233.0014

www.pulsar-inc.com

Write in 33 on Reader Service Card.

CABLE TV BOXES MULTISYSTEM

1. Replacement for all systems.
2. No makes and models required.
3. Built-in copy guard, sleep timer.
4. Volume and remote control, P.G.

1-800-807-6543

30 day money back guarantee and 6 month warranty

Write in 32 on Reader Service Card.

Nuts & Volts Magazine/December 1998 95

your foot. Rolling the cable makes the end round again — cutting or bending a cable often flattens it and makes the stripper nick the wires.

I strip coax cables with a pocketknife. To avoid nicking the braid or the wire, I don't cut all the way through the insulation, but leave a little that I can pull or twist off.

In addition to the tooling, you need the cable and the connectors. RG-58 coax costs about \$0.15 per foot. Cheap BNC connectors cost about \$1.50, and higher quality connectors range up to \$10.00 each. Common brand names for connectors are Amp, Amphenol, and Kings. Make sure you get all the parts — some distributors sell from bulk packaging, and the stock clerks may miss some important pieces for RG174 connectors. Also get the assembly instructions, because the strip lengths are important in making a reliable connector.

Buying a quality used cable for \$5.00 is a better deal than making a new one for \$3.50 (plus the cost of tooling), but I do make some of my cables. The market in new and used RG174 cables is very small, so making them from scratch is more attractive. New RG174 cables from Pomona cost \$18.00, so making just a few cables will pay for the crimp tool.

Cable-to-Cable Connectors

If you want to connect two cables together,

BNC(f) to N(m)	Mouser 161-9736	\$4.17
BNC(f) to TNC(m)	Mouser 161-9734	\$2.18
BNC(f) to Mini-UHF(m)	Halted #590B	\$2.95
BNC(f) to UHF(m)	Halted #950NPB	\$1.95

TABLE 6

BNC(f) to dual banana plug	Pomona 1269	\$5.80
BNC(m) to dual binding post	Pomona 1296	\$10.75

TABLE 7

BNC(f) to Minigrabber clips	Pomona 3788	\$8.20
BNC(f) to Micrograbber	Pomona 5188	\$10.85
BNC(f) to 0.025 sockets	Pomona 5069	\$8.35

TABLE 8

you need a barrel connector (BNC(f) at both ends). A BNC T connector — female at both ends with a male connector sticking out the side — also works. It compromises the impedance match and the shielding, but the T is useful for high-impedance scope and meter connections.

BNC Terminators

You should have some 50-ohm BNC terminators. Many scope inputs are high input impedance, and connecting cables to these inputs causes reflections. A terminator at the input will kill these reflections. Feed-through terminators are best because they minimize stub length, but a 50-ohm terminator attached to a BNC T also works. In desperate times, I've plugged 51-ohm resistors into BNC Ts.

Adapters

Adapters allow you to change a BNC cable into almost any other kind of cable. Adapter qual-

ity and price vary widely. Mil-Spec connectors have good finishes and mate smoothly. Unfortunately, they cost \$10.00 to \$50.00 each. At swap meets and surplus stores, you might find them for about \$5.00. Lower quality adapters cost much less and will serve most users.

Going from BNC to some other connector system could require any of four adapters: two connector and two possible sexes create a total of four combinations. We could require a lot of adapters. Fortunately, most coaxial connections follow a convention: the cables use male connectors and the instruments use female connectors. If all parties follow the cable convention and all cables use BNC connectors, then we need only one combination: BNC(f) to Other(m).

We can cover many conversions with a shopping list that adapts BNC(f) to Other(m). Other adapters need more explanation, and are covered later. I usually get at least two of each adapter that I need. I don't have any TNC or mini-UHF adapters because none of my equipment uses those connectors.

BNC to Dual Banana Plug

Some of my instruments have dual banana jack inputs. Initially, I attached dual banana plugs to shielded cables, but those cables had several problems. They weren't very rugged, and mechanically attaching the cable to the plug was never pretty — knots and cable ties lack aesthetic appeal.

Then I discovered a Pomona 1269 BNC(f) to dual banana plug adapter, and threw away my dual banana plug cables (see Figure 3). The adapter is very rugged, and I use them a lot. A Pomona 1296 is useful for going the other way, but you will use it less often.

BNC to Clip Leads

I've seen many ersatz 1X "scope probes" made from coax cable. There's a BNC(m) on one end, and the other end sports soldered-on alligator clips or grabbers. These probes look ugly and are not sturdy. The coax braid is exposed and can short nodes to ground, and the fine wires in the braid fray quickly. The center lead of a coax cable is fragile, so its attachment to the alligator clip breaks easily. The center dielectric is stiff, so the center cable connection is not very pliable.

A better solution — one that avoids the above faults — uses a clip lead adapter at the end of an ordinary BNC cable (Figure 3). I have two Pomona

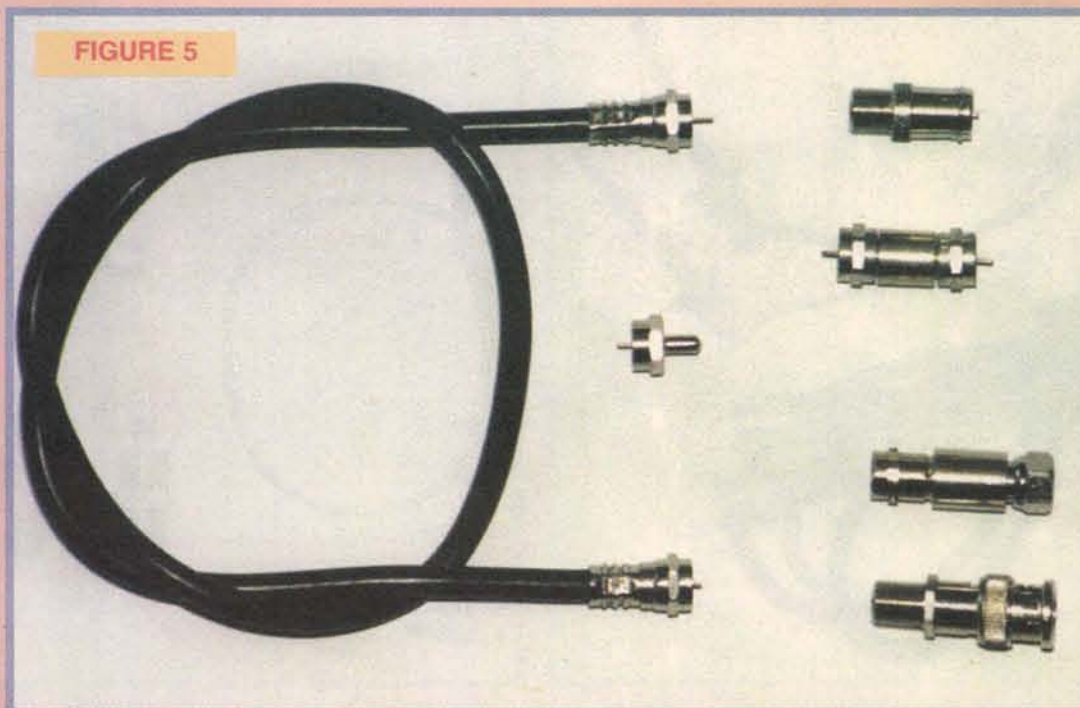


FIGURE 5

3788 adapters (BNC(f) to six-inch Minigrabber leads), and I use them all the time. I'll use one to supply the output of my function generator to the prototype, and the second to connect my digital voltmeter (DVM).

In fact, I almost always use my DVM with the combination of the Pomona 1269, BNC cable, and Pomona 3788; the only problem is the exposed (uninsulated) BNC connectors. The Minigrabber is easier than using a point probe, and the coax cable avoids tangled probe leads. Pomona also has a Micrograbber version, but the 5069 and separate Micrograbbers is a better plan.

BNC to SMA and Friends

For low frequencies, BNC to SMA adapters work okay (see Figure 4), but the conversion from the delicate SMA connector to the larger BNC is mechanically awkward. I often worry that I'm going to break an SMA connector with the lever arm made by the adapter and the BNC cable connector.

For microwave signals, avoid adapters and BNC hardware. Instead, use good cables with SMA connectors. Unfortunately, SMA cables cost a small fortune — \$40.00 to \$50.00 each — and the performance requirements are high enough that you don't want to make them yourself. SMA cables use silver-plated conductors, teflon dielectric, and gold-plated connectors. Instead of buying SMA cables, I bought some microwave hulks and salvaged some cables (and a lot of other stuff in the bargain).

With your SMA cables, you will want some barrel connectors and some BNC(m) to SMA(f) adapters. Although BNC Ts are common, never buy an SMA T.

Some instruments use SMB or SMC connectors, and for these delicate connectors I've thrown in the towel and opted for special-purpose cables (scrounged from microwave hulks or bought from surplus dealers). I have some SMB(m) to BNC(m) cables for my counter, and some SMC(m) to SMA(m) cables for my microwave detectors.

Although there have been several good deals on microwave equipment with hermaphroditic APC-7 connectors, I've shied away because the adapters are too expensive. Used APC-7 to SMA adapters cost about \$70.00.

N Connectors

N connectors are high-performance RF connectors that are used in the Gigahertz range. They offer better impedance control than BNC connectors, handle more power, and are often weather-proof. They are found on signal generators and network analyzers.

By the way, the term N connector is short for Navy connector, and the term BNC is short for Bayonet Navy Connector. The connectors are related in more than just name: an N(m) actually mates with a BNC(f). The other combination (which is the one we want) doesn't mate, so you will need some N(m) to BNC(f) adapters.

If your interest is microwave, then you want N(m) to SMA(f) adapters. BNC does not have the performance.

Almost all N connectors are 50-ohm, but 75-ohm N connectors also exist. Unfortunately, they don't look much different, and inadvertently mating them can wreck one of the connectors. There

BNC(f) to SMA(m)	Halsted #11335B	\$3.89
BNC(m) to SMA(f)	Halsted #11340B	\$3.89

TABLE 9

F(f) to push-on F(m)	Halsted #FC62B	0.69
F(f) to F(f) barrel	Halsted #FC67B	0.39
F(m) to F(m)	Halsted #FC73B	0.89

TABLE 10

BNC(f) to F(m)	Mouser 161-9731	\$2.23
BNC(m) to F(f)	Mouser 161-9733	\$2.21

TABLE 11

BNC(f) to RCA(m)	Halsted #957B	\$1.49
BNC(m) to RCA(f)	Halsted #955B	\$1.29

TABLE 12

are even precision 75-ohm BNC connectors that should not be mated with 50-ohm BNC connectors.

BNC to F Connectors

The overwhelming feature of F connectors is that they are incredibly cheap. The center pin of an F connector is the solid center conductor of the coax cable, and it is easily bent. You must mate the connectors carefully. Their low cost is offset by the time to mate the connectors and the wear and tear on your fingers. If you do any bench testing with F connectors, get some push-on F adapters. These adapters have threaded F(f) on one end

and push-on F(m) on the other. They save time and fingers.

Joining two F-connector cables requires a barrel connector. In some tests, I connect power splitters and directional couplers back-to-back, so F(m) to F(m) adapters are also useful.

F connectors are used in TV systems and imply 75-ohm cable. You will need a collection of 75-ohm (RG59 or RG6) cables. Although all your 75-ohm cables could use F(m) connectors, you will want some BNC 75-ohm cables because BNC connectors are more rugged. TV and cable test equipment use F connectors, but I have yet to see a scope with an F connector. Consequently, you will need two kinds of BNC-F adapters.

The BNC to F adapters don't address the impedance change between 50 and 75 ohms, and sometimes that change is critical. My signal generators, detectors, and oscilloscopes are 50-ohm instruments, so I have a couple of min-loss attenuators to adapt the impedance levels. Sorry, but I don't know an inexpensive source for these parts. When I visit a surplus store, I check the "vegetable drawer" of the Tektronix scope carts for this sort of gold. The store usually gives me a good price for this merchandise they didn't know they had. Twice I have considered buying a scope cart just for the contents of the drawer: once for the connectors and once for the scope manuals.

Audio

There is also tremendous variety in audio connectors, and a trip to the local audio store or RadioShack will let you load up on adapters among audio connectors using phone, miniature

phone, subminiature phone, and RCA phonograph varieties. There are also mono and stereo variations of some connectors. Serious users will want some XLR connectors. Pay particular attention to the types of cables: there are speaker cables and microphone cables. The latter cables are shielded for low-level signals.

It doesn't make sense to use BNC cables as the standard in audio work. Instead I use subminiature stereo phone cables as the standard cable. Occasionally, you will want to connect an audio signal to your scope, and about the only common adapter is a BNC to RCA phonograph. I have both directions for this adapter, and have been surprised how often I use them. Many cheap radio and TV tuners use RCA jacks for RF connectors.

Most audio connections are 600 ohm, but the cable impedance is not 600 ohm. Reflections and impedance matching are not usually a problem at audio frequencies because the shortest wavelength is about 15 kilometers. **NV**

RESOURCES

HALTED SPECIALTIES, www.halted.com
1-800-4-HALTED, 408-732-1573

IDEAL INDUSTRIES, INC.
www.idealindustries.com
1-800-435-0705

ITT POMONA ELECTRONICS
www.ittpomona.com
909 469-2900

MOUSER ELECTRONICS, 1-800-346-6873

GIFT SUBSCRIPTIONS HALF PRICE!!

That's right!

Buy or renew your own subscription to *Nuts & Volts* at the regular price, and order a second subscription to give to a friend or family member and pay half the regular rate!!

Along with your subscription order, include the name and address of the person to receive the gift subscription, and we'll send them a special holiday card announcing their gift.

Offer applies to any length, PREPAID USA-delivered subscriptions only!!

NUTS & VOLTS MAGAZINE
430 Princeland Court, Corona, CA 91719
909-371-8497 • 909-371-3052 FAX
Subscription Order ONLY Line 1-800-783-4624
E-Mail: subscribe@nutsvolts.com

* SANTA SPECIAL *



Offer expires January 1, 1999.

Opto Hits The Spot



SCOUT

- 10MHz - 1.4GHz
- Stores 400 frequencies in memory
- Reaction Tune the ICOM R7000, R7100, R8500, R9000, R10, AOR 8000, AOR 8200, and Opto R11
- 10 digit LCD with signal strength bar-graph
- Vibrator and beeper alert mode

\$349 SAVE \$100

DB32 Antenna Sold Separately (\$29)



R11

- 30MHz - 2GHz wide band receiver (Cellular Blocked)
- Built-in speaker for instant audio demodulation
- LED frequency range indication display
- Reaction Tune with Scout
- Capture 5 watt UHF signal from 500 feet
- 1000 frequency lockout

\$299

TA100S Antenna Included



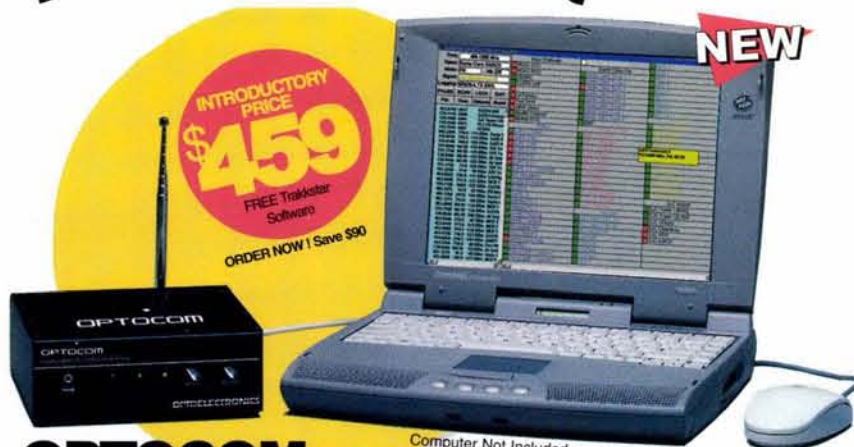
XPLOER

- 30MHz - 2GHz (Cellular Blocked)
- Two line LCD frequency display
- Decode CTCSS, DCS, and DTMF
- 500 memories
- 1000 frequency lockout
- Built-in PC interface
- Capture 5 watt UHF signal from 800 feet

\$799 SAVE \$100

TA100S Antenna Included

In The Spotlight



OPTOCOM

- High speed triple conversion GRE receiver
- Track Motorola 400, 500, 800, and 900MHz systems
- Decode CTCSS, DCS, LTR, DTMF, and Motorola talk group IDs
- Scan trunked and conventional frequencies simultaneously
- Reaction Tune with Scout Frequency Recorder
- Software Controlled volume & squelch for remote control operation

- Store & Scan, download up to 28 different frequencies or one talk group ID for scanning without computer control
- Supplied with the all new Trakkstar software
- Trunk Track LTR systems
- Scans conventional frequencies from 25-250, 760-823.995, 849.005-868.995, 894.005-1300MHz (Cellular frequencies blocked)

Computer Not Included

Special Prices are for a Limited Time Only!!



COUNTERS

Handheld frequency counters, all incorporating patented Digital Filter and Digital Auto Capture. All counters come with initial accuracy of +/- 1ppm. High impedance amplifiers standard on M1 and 3000APlus. Call for additional features on all three counters.

CUB \$149
M1 \$199
3000A+ \$299

SAVE \$50 on the M1 & 3000A+

Antennas Sold Separately

OPTOTRAKKER



- Decodes CTCSS, DCS, LTR, Motorola Type I and II, and DTMF
- Scan multiple trunked systems at the same time under computer control
- All trunked frequency bands supported, including 400MHz, 500MHz, 800MHz and 900MHz
- Built-in Data Slicer Circuit
- Pass through technology requires only one com port

\$299 Includes Software

Receivers supported under computer control: Icom R7000, R7100, R8500, R9000 and R10, AOR AR8000, AR3000A, AR5000, and Pro 2005/6 with OS456/OSLite, Pro 2035/42 with OS535



OPTOSCAN

- Computer control scanning interface board for the popular RadioShack Pro 2005/6 (OSLite) and Pro 2035/42 (OS535).
- Decode CTCSS, DCS, and DTMF with OS535

only Supported by popular third party software

\$175 SAVE \$24
OS456Lite: \$99



TECHTOYZ

Micro Test equipment in pager style cases featuring a 2000 character DTMF decoder, a Frequency Counter with three memory hold, and an RF Detector with settable threshold alarm.

Micro Counter \$99
MicroDTMF \$99
MicroRF Detector \$149

Purchase all three for \$299 Save \$48

TMC100 Antenna Sold Separately (\$9)

FACTORY DIRECT ORDER LINE 800-327-5912

Made in the

U.S.A

www.optoelectronics.com

OPTOELECTRONICS®

5821 N.E. 14th Avenue • Ft. Lauderdale, FL • 33334

Telephone: (954)•771•2050 Fax: (954)•771•2052 EMail: sales@optoelectronics.com

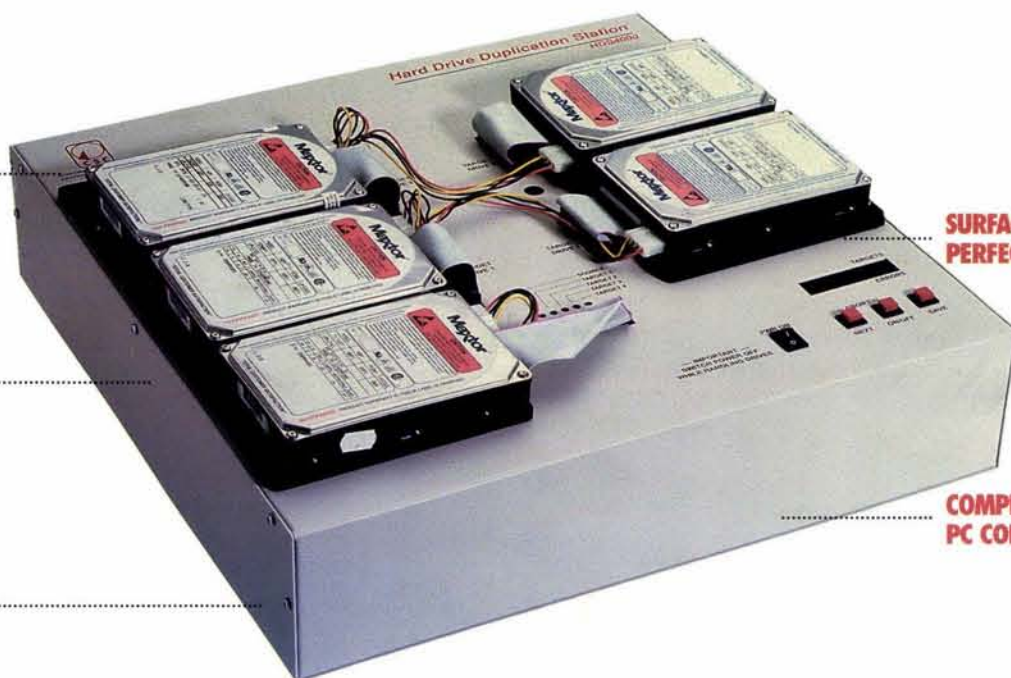
Prices and Specifications are subject to change without notice or obligation

The OptoCom has not been approved by the Federal Communications Commission. This device may not be sold or offered for sale until the approval of FCC has been obtained. Contact Optoelectronics for information on availability. Optoelectronics, ScanStar, Motorola, EF Johnson LTR and Microsoft Windows are all registered trademarks. Scout, 3000A+, R11, Xplorer, MicroCounter, M1, Cub are covered by U.S. Patent No. 5,471,402.

**FIVE INDIVIDUAL
CONTROLLERS
FOR FULL PERFORMANCE.**

**HIGH PERFORMANCE
INTEL EMBEDDED
RISC PROCESSOR.**

**COPIES EVERYTHING:
PARTITIONS, O/S,
PROGRAMS - THE WORKS!**



**SURFACE ANALYZER FOR
PERFECT COPIES.**

**COMPLETE SYSTEM - NO
PC CONNECTION REQUIRED.**

COPY HARD DRIVES INSTANTLY!

"THE FASTEST WAY WE'VE FOUND TO MASS PRODUCE SYSTEMS." ANDY HSU, GENESIS TECHNOLOGY

BUY MANUFACTURER DIRECT: \$895
408 330-5543

FOUR DRIVE DUPLICATOR

Copy entire hard drives with ease. Drive duplicators are an essential tool for dealers and system builders. Why spend hours installing and formatting drives when you can clone four at once? This high speed, stand-alone IDE copier is easy to use and totally self-contained.

Set up any IDE or Ultra-DMA drive with all your original software. Connect blank drives and press "copy". You'll completely duplicate

four drives faster and more accurately than you can copy just one on a PC!

Notebook and desktop drives are supported. Five separate ports let you copy drives at full speed without changing jumpers. Other copiers slow down with two or more drives attached. This true parallel transfer duplicator runs at full speed regardless of the number of drives attached. The built-in surface

verification scans drives for perfect data integrity.

Call now and get the duplicator chosen and approved by Computer Sciences, IBM, and Maxtor.

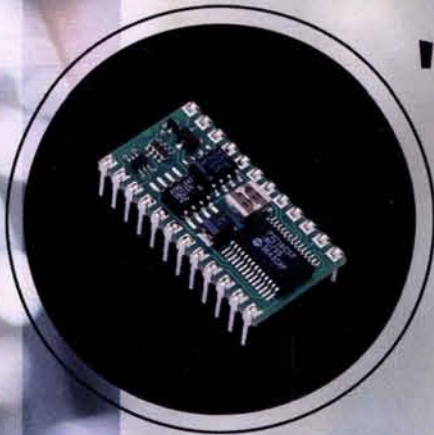


CORPORATE SYSTEMS CENTER
3310 WOODWARD AVE., SANTA CLARA, CA 95054
WWW.CORPSYS.COM

This product is sold and intended for legitimate in-house duplication purposes only.
Copyright laws must be observed.

New Year's Resolution #1

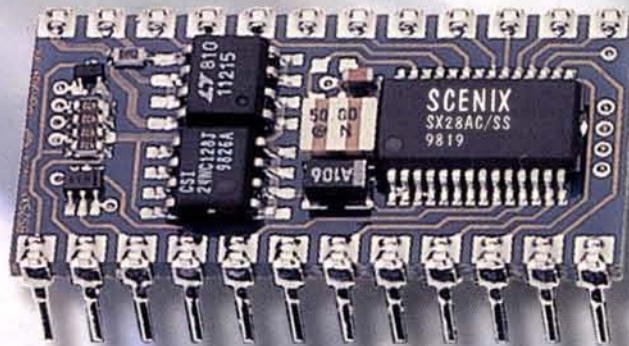
"I will run faster in 1999."



In fact, the BS2SX-IC runs 2.5 times faster than the BS2-IC! With a 16K Byte EEPROM storing up to 4,000 lines of PBASIC code, the BS2SX-IC is an ideal solution for BASIC Stamp customers who have been limited by speed, program size, and RAM. Documentation is available at our website.

Price is \$59 quantity one (1) and it's available today. Interpreter chip OEM format will be available early 1999.

**INTRODUCING the
BASIC Stamp II SX!**



	BS2-IC	BS2SX-IC
Microcontroller	Microchip PIC 16C57	Scenix Semiconductor SX28AC/SS
Program Execution Speed	4,000 instructions/sec.	10,000 instructions/sec.
Processor Speed	20 Mhz	50 Mhz
Program Memory Size	2k Bytes	8 programs x 2k Bytes ea. (16K Bytes)
RAM Size	32 Bytes	32 Bytes
Scratch Pad RAM	N/A	63 Bytes
Current @ 5V	8ma Run/100µA Sleep	60ma Run/200µA Sleep
Source/Sink Current per I/O	20mA/25mA	30 mA/30mA

PARALLAX

To order call **916.624.8333**
For more information please visit our
website at <http://www.parallaxinc.com>

BASIC Stamp and the Parallax, Inc. logo are registered trademarks of Parallax, Inc.
Scenix is a registered trademark of Scenix Semiconductor, Inc.
Microchip is a registered trademark of Microchip, Inc.

Write in 194 on Reader Service Card.

NUTS & VOLTS MAGAZINE
430 PRINCELAND COURT
CORONA, CA 91719

CHANGE SERVICE REQUESTED

BULK RATE
U.S. POSTAGE
PAID
PERMIT No. 359
LONG BEACH CA

